Fertile ground:

Enhancing local food production in Delft, South Africa.

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- Abstract -

This dissertation, situated in Delft, on the eastern edge of Cape Town, aims to improve livelihoods by establishing a productive urban agricultural operation that will create jobs, supply healthy food and re-establish farming as a lucrative business in an impoverished community. It is intended to inspire people to transform the landscape of local food production and sustainable agricultural practice.

Most impoverished communities tend to feel the effects of a formal food system that is set up to deliver to more established urban areas. This forces low-income communities to rely on informal retail to supply healthy foods, often at a premium, both for user and supplier. Food supply chains are dispersed resulting in high food costs and over-reliance on an extensive transportation sector. My project aims to decrease this footprint allowing nutritious foods to be grown and sold locally, benefitting both the consumer and the producer.

By investigating the leading NGOs promoting urban agriculture and food security in the Western Cape, I have been able to extract valuable spatial lessons from these organizations. I have then applied them to create a model of urban agriculture and local food production that can work in these demanding landscapes.

I explored the natural and urban conditions at various scales to determine the number of inputs required for a successful operation. I also investigated selected technologies to enhance land productivity and food production as well as selected systems to establish a sustainable operation in a landscape where resources are valuable and scarce.

With high unemployment a regular statistic in impoverished communities, there will always be labor available and when given the opportunity, local residents can take advantage of the many benefits that such a project can deliver. I hope to develop a model that can be implemented around communities all over South Africa and the world, where common challenges of food insecurity faced by millions of people everyday can be addressed through local food production and in the process, establish a new type of agricultural model that can supply both the formal and the informal food sectors.

My project is about celebrating a new agricultural model, one that is integrated into the urban landscape with a particular focus on local production within an impoverished community. It consists of a production farm with educational, research and retail components and a large-scale greenhouse that is intended to change the landscape of Delft. The farm will run various agricultural operations in a sustainable manner where are resources and waste is recycled and reused allowing for a closed loop operation. Growing, processing, packaging and distributing of produce will take place from this centralized hub. The greenhouse will be the celebratory moment of my project and I envision it to transform the landscape of Delft and the way in which the farming is perceived from a local perspective. The building will showcase all kinds of food growing technologies and will become a landmark in the area as a place of education and production. Specialized crops and seeds will be cultivated, stored and displayed for visitors from around the world, a one of a kind building that fuses food production, education and public interaction.

- Preface -

> My fridge is empty and I decide to go shopping for ingredients to cook dinner. I drive to my local shop and buy some lettuce, chilies, tomatoes, avocado and sweet potato from the vegetable aisle. Everything gets paid for and packed in plastic bags and I drive home ready to cook. This is a standard procedure for people like me.

Not many people are aware where their food comes from and are happy to buy what they need from their local supermarkets. Their thoughts don't go further than this. However, since I've started to deal with this topic, I have discovered the deep networks that exist within our food system. Big corporate companies control the market, the price of fresh foods as well as their distribution channels. They have their connections that supply them throughout the year, in and out of season, and stick to these suppliers to meet the demand, even if it means travelling great distances or importing produce. (Battersby, Haysom et al., 2015b)

To meet the high demands of the big corporations, commercial agricultural farms rely on unsustainable methods to produce at a quicker rate around the clock. Land gets overworked, soil loses fertility while pesticides and large machinery are used to increase "productivity" and prevent crop loss. The reliance on these commercial farms for most of the produce found in supermarkets also effectively kills the small farmer, as they cannot compete with the scale, the speed and subsequent prices at which these commercial farms can supply produce. This affects most areas outside of the city as the big corporations mostly supply supermarkets in cities and areas of medium to high income leaving the informal trade sector that mostly supplies the lower-income areas to fight high prices and long distances to acquire produce. (Turok, Hunter et al., 2011), (Brown, 2008)

This system is flawed in many ways, from driving up prices because of transportation, refrigeration, packaging and distribution to incredible amounts of food waste, unsustainable farming methods and a distinct lack of service and products in low-income areas, not to mention high consumer and low supplier prices. A high percentage of the cost of food is down to the cost of transport and packaging, two steps than can be dealt with easily when food gets produced locally.

> Going back to my dinner, suddenly I'm aware of what I'm eating and the consequences of supporting the formal top-down food system. My mind has many questions now: Where was this lettuce grown? Did they use pesticides on it? Where does the plastic packaging go after I throw it away? How long will it stay fresh after I open it? How much did the farmer receive for this piece of lettuce? What was the price I paid again? I check, R18 for about 10-15 large leaves. I can only guess the farmer received anything between R1-2 for a whole lettuce, where 50% gets thrown away because of slight damage. The same questions are thought about regarding my tomatoes, my sweet potatoes and all the other fresh produce I'm putting in my salad. This was a reality that I was blindingly living past every day of my life, until now.

The point I am trying to make is that when people are alerted to these questions it raises awareness. This awareness leads to curiosity, that leads to investigation and what you will find out, will most probably make you think twice about buying that bag of lettuce from your local supermarket chain and rather buy from a farmers' market that supports local farmers. It will open a whole new world of local production, seasonal growth, organic farming methods and the importance of supporting your local farmers and small handlers. Not only will you get higher quality and fresher produce, but produce that is largely grown with organic principles, by people who walk on the soil and care for the soil, the plants and allow nature to thrive again like God intended it.

Our natural resources are being depleted, millions of people are undernourished while big corporate companies bank accounts grow ever larger. There needs to be a change in the way we produce food, supply food and sell food. The best thing about this is that it has already started and it is growing steadily and through educating more people we can start to make a change. A change that will not only benefit the end user, but also the farmer, the supplier, millions of people suffering from mal-nourishment and importantly, the land. (Shaw, 2007)

Image 1: Oranjezicht City Farm Market selling fresh produce produced by local farmers

- Introduction -

My research has led me to the question of addressing issues of food security through local food production in the neighborhood of Delft, on the eastern edge of Cape Town. Is it possible, through sustainable urban agriculture, to locally produce and supply healthy and nutritious foods to an impoverished community that is affected by the formal, top-down food system leaving thousands of people undernourished and vulnerable everyday? It is of utmost importance to understand the urban, social and natural conditions to attempt to establish operation that is capable of sustaining the demands of such a rigorous and challenging environment.

I chose Delft as a site after identifying various natural and urban advantages in its location. It has good access from adjacent highways, is relatively close to important existing food markets and in the same landscape as the successful Philippi horticultural area where a large portion of Cape Town's fresh produce is grown. There are natural systems to benefit from namely the productive Cape Flats aquifer, manageable soil conditions and existing conservation and bio-diversity areas that will benefit from re-establishing nature in highly developing and dense urban areas.

Delft, like many impoverished areas, is a neighborhood with high unemployment rates, an abundance of vacant land and an informal economy and retail sector. This means healthy and nutritious foods are not always accessible and often overpriced, begging for an alternate system to supply these goods locally and to change the way under-nourished families eat on a daily basis. This urban setting, along with the available labor and open spaces, allows me to test these ideas of urban agriculture and local food production in a landscape that can benefit immensely from such an operation.

In section one I investigate selected NGOs involved with urban agriculture. I spent a lot of time following and investigating these organizations to extract valuable spatial lessons from their models. They also operate in similar urban conditions and by following them closely I was able to get a much better understanding of the urban and social environment I would be working in and the challenges that brings.

In section two I investigate and identify selected technologies and systems to improve food production and allow for a sustainable, low input – high output, operation. These technologies and systems would become a key component to the success of my project.

In section three investigate the agricultural potential of Delft as a site for food production. By getting a better understanding of the urban conditions and natural resources I am able to enhance the productivity of land in a landscape where land is valuable and resources are scarce.

In section four I look more closely at Delft and identify a site based on requirements and opportunity. My project would involve lots of supporting programme, identified through my research, and this would contribute to identifying the site and the strategies I aim to implement.

In chapter five I develop my urban strategy and a series of urban systems. Being a farming operation, large open land was always going to be favorable to establish the farming component and this required an urban strategy to hold it together and tie it into my site and project successfully.

In chapter six I will have a more in-depth look at my selected site. Here I will develop my concept further and explore different site strategies based on the location of my site, the existing conditions and the requirements of my programme.

In chapter seven I will develop the heart of the whole operation, the Seed. All my research will be applied to be able to create a successful and sustainable hub where the programmatic requirements meet the architecture. I will investigate and develop a series of systems together with selected technologies to allow for a seamless and streamline operation serving the agricultural and supporting programme. By investigating the spatial, social, sustainable and systematic requirements I am able to create a series of buildings, reminiscent of traditional farming architecture that will contain the various programmatic components. Once these buildings are established I turn my energy into creating a landmark building for the whole operation, showcasing all the technologies and systems used on site and incorporating them into one, energy efficient building that stands proudly in the landscape as an advertisement for urban agriculture and food growing technologies. This building would be one of the first of its kind to integrate food growing and public inhabitation into one self-sustaining building.

- The issue of food security -

Food insecurity has become one of the most critical issues in the contemporary world. Rapid urbanization is ensuring that food security is becoming an urban issue where most people living in poverty can't afford or access the right kinds of food. Urban food insecurity is characterized by low dietary diversity, high malnutrition and obesity, and distinct hunger seasons. This is mostly due to low household income, income instability, geographic access to a range of foods, access to transport and stability of food prices. (Battersby, Haysom et al., 2015b)

Food security is fundamentally linked to the structure of the food system. South Africa is food secure on a national level but yet there are still a very high number of people who are food insecure. A recent study done by the Development Bank of Southern Africa (DBSA) showed that 70% of the urban poor in South African cities are food insecure. Cape Town has one of the highest levels of food insecurity with 80%, the majority of whom live on the periphery of the city with limited access to the formal economy. (Turok, Hunter et al., 2011), (Battersby, Haysom et al., 2015b)

Food prices appear to be one of the main drivers of food insecurity. The further food is grown from the source of consumption, the greater the need for transportation, preservation and storage, resulting in higher prices. These rising prices, along with the shortage of options for accessing healthy food if you live in a low-income neighborhood, forces many household to rather buy cheaper, less healthy food that can be conveniently accessed within the community from informal traders. South Africa experiences a big gulf between large food retailers and small-scale informal traders with little in between, geographically or economically. Some 60% of food sold in 2002 in South Africa was through the supermarket, making it the world's most supermarket-dominated food economy. (Turok, Hunter et al., 2011)

The current food system relies strongly on commercial agriculture to supply the demand of the supermarkets and other large retailers. This is not sustainable as demand is too high, driving commercial farms to increase the speed of production to meet these demands. The use of pesticides, large machinery and vast amounts of water leads to rising prices while damaging and exhausting valuable agricultural natural resources such as soil and water. (Brown, 2008)

Urban agriculture, the practice of farming in an urban environment rather than on rural land, has been shown to produce much higher yields with much more efficient use of water and land than commercial farming with many added benefits. Many first world cities are actively encouraging urban agriculture (local production) and local markets, making food more accessible, increasing the number of small-scale farmers and making cities more resilient to changing climatic and economic conditions. These cities have reduced their dependency on food imports, stabilizing their market price and also building stronger communities through integrated markets and social connections. (Turok, Hunter et al., 2011)

There are attempts from a number of national government departments to support urban agriculture to facilitate economic development and to alleviate food insecurity, but it is still not addressing the major issue. South African cities need to spend their energy on creating a flourishing local food sector as a

means to address food security. Making the food system work for the poor can have significant impacts on the economy, employment, environmental sustainability and health costs of a city. (Battersby, 2011)

I will look to address these issues of food security through studying the leading organizations that are involved with urban agriculture in an attempt to solve issues of food security in the Western Cape. Through studying their organizations and their daily operations, I will look to extract valuable information and spatial lessons to help me to address these issues in a constructive and successful manner in my project.

Organizations involved with food security and urban agriculture in Cape Town

Abalimi Bezekaya, Oranjezich City Farm, Soil For Life and Elsenburg Agricultural Institute are all important and active contributors to urban agriculture within the Western Cape. These organizations mostly operate within the same context, within the same demographic and with the same end goal – to support and empower people with little hope, income and education to be able to create their own sustainable livelihoods with the limited resources and land available to them. Through investigating them, I aim to uncover the spatial configurations and networks in which they operate and what exactly they deliver to the farmers and to the public within these networks of agricultural food production and services.

Abalimi Bezekaya

Abalimi Bezekaya is a non-profit organization that assists individuals, groups and community-based organizations from disadvantaged communities to initiate and maintain organic food growing projects as a basis for sustainable lifestyles, (self help) job-creation, alleviation of poverty and environmental renewal. Their vision is for people to recognize the link between their survival, their health and the active improvement of the area; to give them the confidence to initiate, replicate and sustain food growing activities; and to see the potential that these actions could be an entry point to other development activities that can improve their lives. (Abalimi, 2013)

Abalimi is affiliated with two organizations that are of specific interest with regards to food security and urban agriculture: “The Farm and Garden National Trust” and “Harvest of Hope”.

“The Farm and Garden National Trust” assists the micro-farmers of Abalimi to start-up and maintain successful urban agricultural projects with the limited resources available to them. Services include:

1) Education and extension services – this includes training, education and scientific support services.
2) A dedicated market for small farmers – no small farmer can survive against the corporate mainstream, they need to pull together and create their own market.
3) Accessible and affordable input costs - manure, seedlings and seeds must be affordable and accessible to the farmers.
4) Capital (subsidy) – emerging small farmers can’t be loaded with debt so the trust offers them free gift capital.

(Small, 2016)[1]

[1] Rob Small – Co-founder of Abalimi Bezekaya

Harvest of Hope (HOH), established in 2008, is a community supported agriculture “veg box” business. It is the first of its kind where over 120 micro-farmers from poor communities supply high quality fresh produce to the open market from small pieces of open land available to them. All profits go back to farmer support and development. Abalimi currently has over 6000 family micro farmers on its register and HOH signs production contracts with a number of these home and community farmers. HOH supplied 450 veg boxes to members in Cape Town in 2015 but demand exceeded supply and HOH could have over 1000 members currently if the micro-farmers were able to keep pace. (Small, 2016)

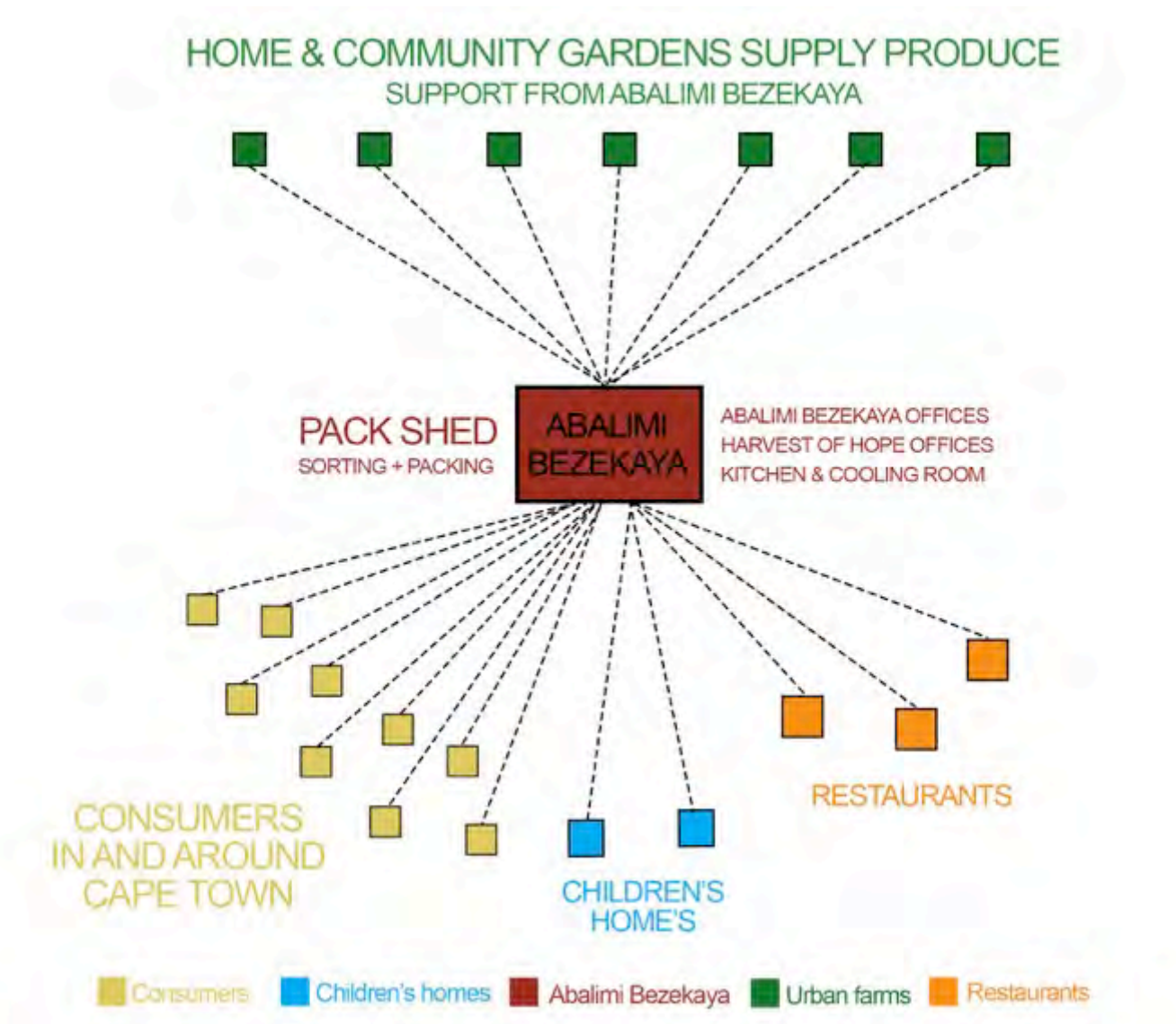


Image 2: A diagram of the Abalimi Bezekaya operation (Not to scale)

Abalimi Bezekaya’s “Harvest of Hope” operation is based around a centralized packing shed where produce flows through on a daily basis. Produce is grown on urban farms around the Cape Flats and picked up by designated drivers that deliver it to the pack shed for cleaning, sorting and packaging. From this centralized point, the packaged produce is distributed to designated pick up points, restaurants and children’s homes around the Cape Metropolitan. The pack shed, situated in Philippi Village in Nyanga, is around 300sqm and includes a cooling room, a kitchen and a boardroom. The ground floor is used for packing, sorting and storage with offices upstairs.

HOH currently supplies up to 650 vex boxes on a weekly basis to members and selected restaurants around the Cape.

A typical week in the pack shed works as follows:

- Mondays - pre-packing herbs and certain vegetables.
- Tuesdays – Harvest of Hope; vegetables are collected, sorted and packed into bags for delivery. Sponsored bags (the public can sponsor weekly bags) are also taken to children's homes in the area. Abalimi Tours takes place on a Tuesday and ends at the pack shed, introducing like-minded people to the heart of the operation.
- Wednesday, Thursday and Friday - restaurant sales while any excess produce left on Fridays are donated to the community.

Abalimi as a whole, including HOH, employs 17 full time staff, 10-15 part-time / casuals as well as a varying amount of volunteers. On Tuesdays, volunteers from the community (usually local farmers) help the staff to sort and pack the veg boxes.

Image 3: Sorting table in the Abalimi pack shed.

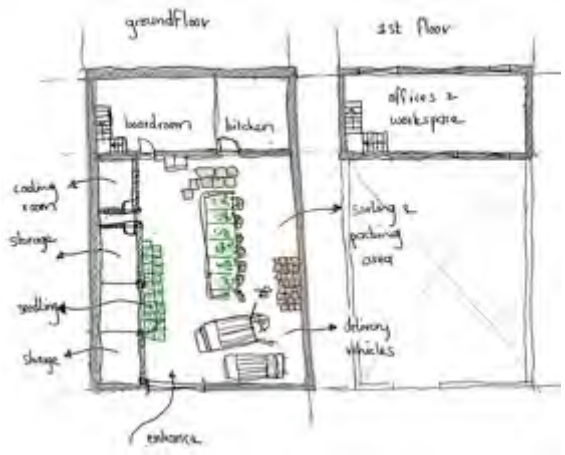


Image 4 (top): Seedlings in the pack shed.
Image 5 (middle): Veg boxes ready for delivery.
Image 6 (bottom): Sketch plan of the pack shed.

Abalimi have identified various stages that an urban farm goes through since its inception that have different economic implications and opportunities. The stage I'm most concerned with is the livelihood stage, just before reaching the commercial stage, where single farmers can earn up to R6000p/m on a 500sqm piece of land while harvesting enough additional produce to feed them and their families year round. This 500sqm size plot would also later become my reference size for sub-dividing land.

These farmers supply the niche markets where the ethical middle class consumer likes to buy. They don't interfere with the formal food system and, without threatening the big commercial players, they can feed the nation on this model. (Small, 2016)

Abalimi is a successful model that is attracting young entrepreneurs from the corporate world. They believe they have a system (the African Family Management System that based on the traditional African villages where the mother is at the heart of the operation) that can be a success in South Africa, with democracy at the forefront. (Small, 2016) The annual growth and the success of their projects are testament to their dedication and to their beliefs and if they continue along this trajectory, they will become an important link in supporting local food production.

Image 7 Left: Subsistence level garden using leftover space at the Fezeka Municipality in Gugulethu. The land is owned by the municipality and leased to the farmers on a “pay what you earn” basis.

Image 8 Right: Early livelihood garden established on the grounds of Gugulethu Comprehensive school with a 5 year renewable free use agreement in the form of a simple letter of approval signed by the schools governing board and the school principle.

Image 9: Commercial garden and Garden Centre of Abalimi Bezekaya run by Mama Mabel Bokolo.

The key spatial lesson I learned from Abalimi Bezekaya:

Which processes can be centralized and which can be dispersed. As demonstrated by the map, Abalimi supplies huge amounts of fresh vegetables weekly without possessing any farmland and relies solely on registered urban farmers to grow their produce. This means farmland can be dispersed while produce gets sorted, packaged and delivered to and from a centralized hub, establishing the operation as a link between the farmers and the consumers. This business model also allows producers and consumers to build up strong relationships with Abalimi Bezekaya that have many benefits for current and future business.

Oranjezicht City Farm

The Oranjezicht City Farm (OZCF) is a non-profit project celebrating local food, culture and community through urban farming in and around Cape Town. They are building social networks within the community, developing skills among the unemployed and educating residents and their children about growing food, recycling and other environmental issues. (OZCF, 2016) OZCF believe that we, as individuals, can bring about change by choosing what we buy and cook and through understanding where the food comes from. Through educating our peers and supporting local farmers, we can influence decisions that can and will support a better local food system. Because the farm is a non-profit organization the founder, Kurt Ackermann, had to expand the organization to sustain the farm and subsequently created the OZCF market.

The OZCF market is a community farmer-style market for independent local farmers and artisanal food producers that takes place every Saturday at the V&A Waterfront in Cape Town. They encourage the public to do their weekly shopping at the market and, in turn, help to build an alternative food system. The market is perceived as a niche, lifestyle choice market, and although that might be true, the real aim remains to support the local production of food, ranging from the informal urban micro-farms to the more formal artisanal food producers. (OZCF, 2016)

OZCF also recently established the OZCF Trust that is a food-systems NGO and provides technical support to small-scale independent farmers with high potential. Much like Abalimi, they identified this as a crucial service to independent farmers to give them the chance to establish and maintain a successful urban farm in a low-income community.

Image 10: Oranjezicht City Farm

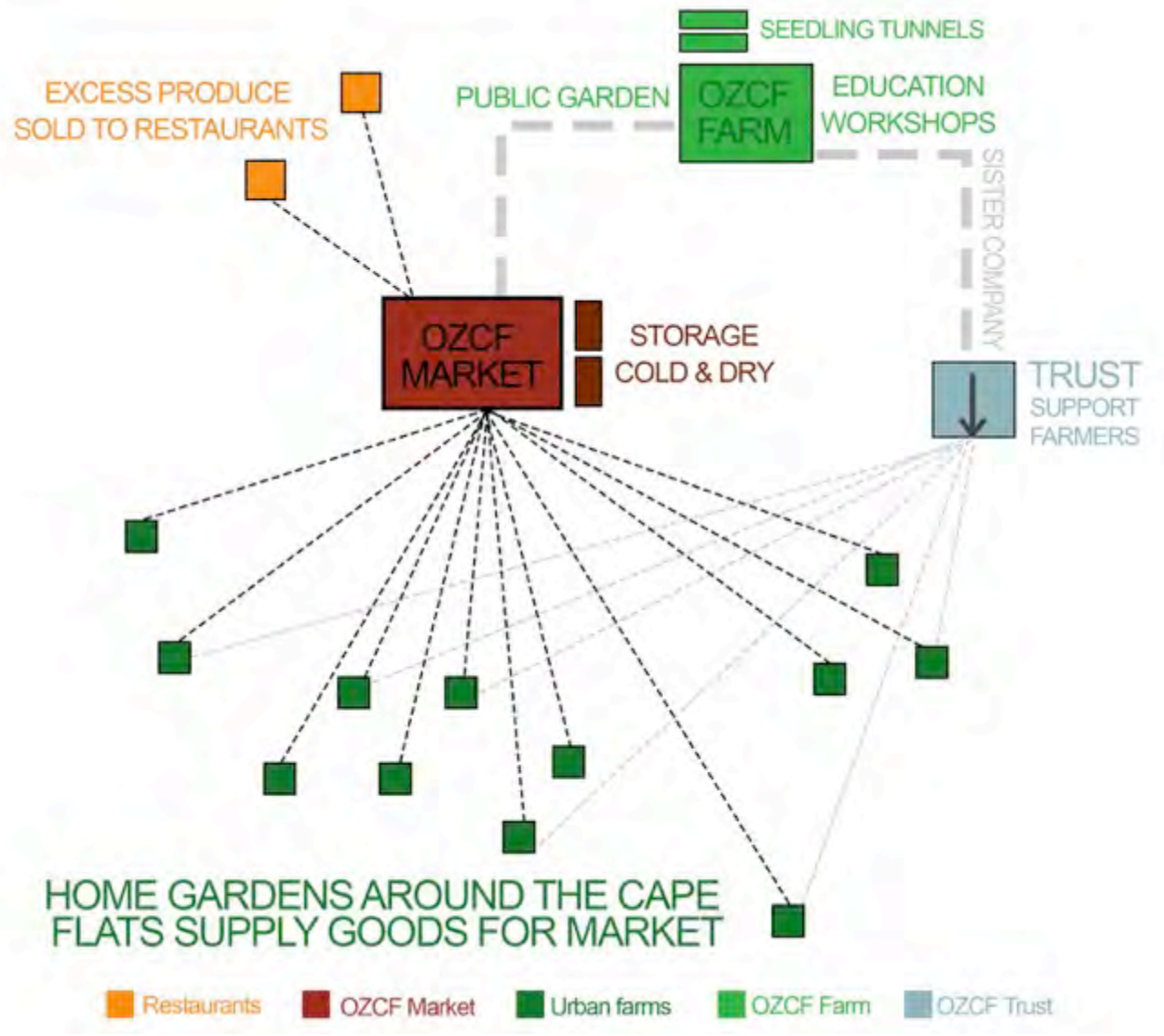


Image 11: A diagram of the OZCF operation (Not to scale)

The farm is approximately 2250sqm with a composting area of 55sqm and a small nursery. The farm is open to the public and the produce from the farm is usually sold at the OZCF market. It is also used as an outdoor classroom and training space where kids and adults come to learn about food and food related knowledge such as soil, planting, crops, seasons, growing cycles, insects, composting etc. There are currently two pilot projects with two schools from Vredehoek in Cape Town where OZCF, in conjunction with the teachers, run a part of the curriculum. Training, education, tours and general up keep is done by three full time staff members.

The OZCF market has 3000 visitors weekly buying local produce. Small farmers from Phillipi, Nyanga and Khayelitsha supply vegetables to the market. All produce is grown with organic principles and the whole process from growing to selling is very transparent and honest. (OZCF, 2016) If there is any excess produce, it either gets sold to local restaurants or given to the workers on site. There are two containers on site; one is for storage of market goods such as tables and chairs, the other is used for storage of produce and food and includes a cold room.

The OZCF trust focuses on supporting small-scale independent farmers to successfully setup and maintain the business side of farming. This includes managing cash flows, cash flow projections, insurance, access to markets, logistics and proper planning. The trust will also identify and develop missing links required to establish a healthy local food system. Institutions such as a land bank, a seed bank and a co-op need to be in place for small-scale farmers to succeed and to work together in establishing small-scale farming as a fruitful practice in South Africa. (Ackermann, 2016)[2]

[2] Kurt Ackermann – Founder of Oranjezicht City Farm

The market is seen as an integral part of the OZCF operation and as a blueprint to successfully initiate many more farmers markets around the Western Cape. It is of utmost importance to have a dedicated market for small-scale urban farmers to succeed and for local food production to really flourish in a sector of its own. By establishing these markets the vision is for local food to be grown to the point where people in poor working class communities buy these foods without thinking about it. If this model is achieved, local production could supply the informal retail sector and establish it as a functional and sustainable economy to many people of Cape Town and South Africa. (Ackermann, 2016)

Kurt Ackermann (founder of OZCF) stated: “Looking forward 5-10 years, there is hope that the trust will help establish and set-up another 10-20 markets around Cape Town and to support more and more independent small farmers to get their produce into the food system”, albeit an alternative food system such as the informal sector. If this flourishes, “the Trust aims to prove the market potential to the big retail chains in an attempt to work with them and pilot some ideas with them.” (Ackermann, 2016)

The key spatial lessons I learned from OZCF:

A community farm can become the heart of a bigger business that included a market and a trust and provided small-scale farmers with a platform to sell their produce and earn some money. The market established connections to the culinary sector, providing selective and desired produce, further broadening the opportunities for local farmers to grow more specialized crops and earn bigger profits. Lastly, the power of the farm as a public and educational space; a place where locals can gather and meet, where kids can play and learn and a place of beauty and escape from the urban jungle where community ties are strengthened.

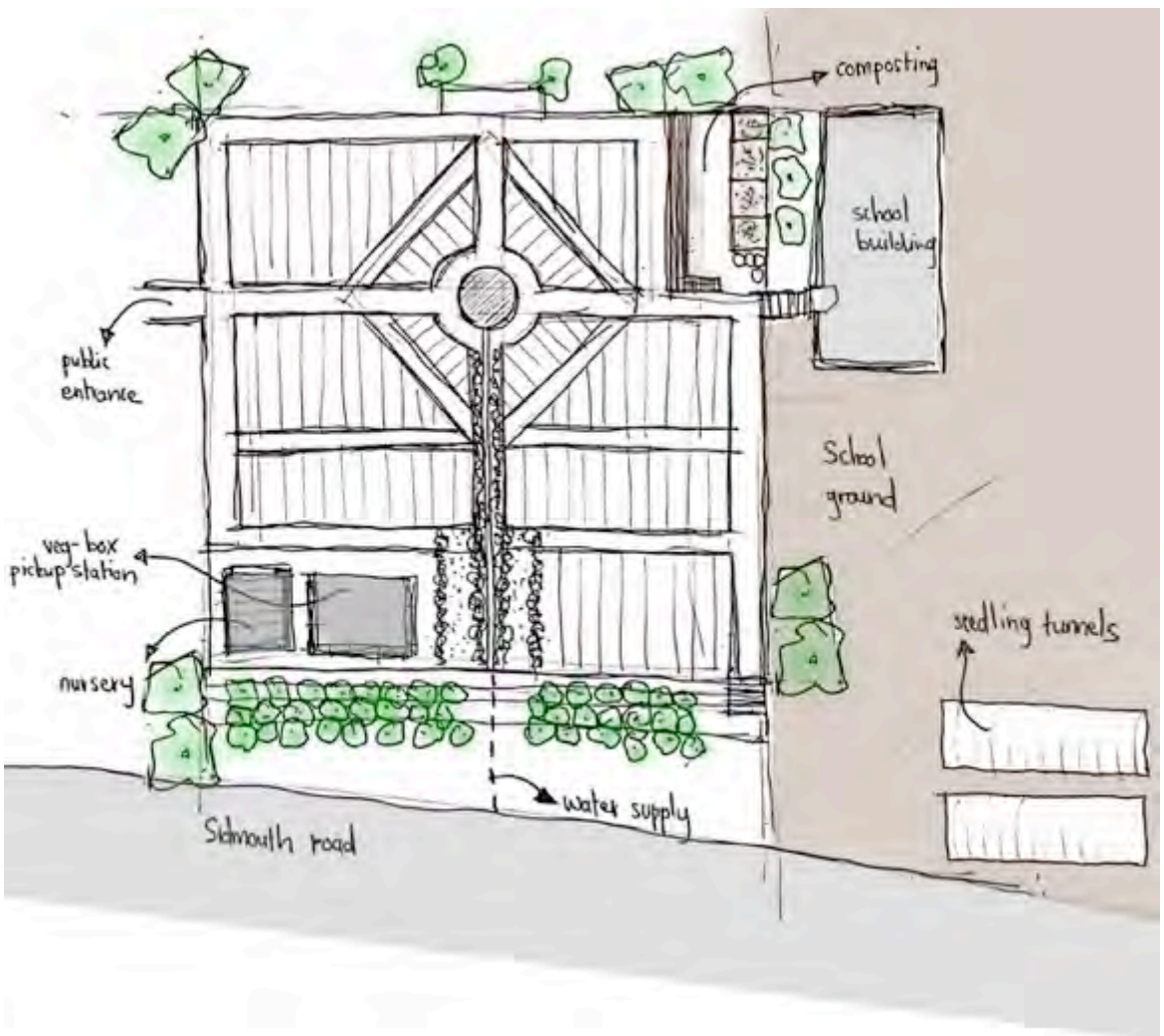


Image 12: Sketch plan of Oranjezicht City Farm (not to scale)

Soil For Life

Soil For Life (SFL) is a non-profit organization based in Cape Town that trains and educates people in organic* food gardening. They mostly work in the townships of the Cape Flats area teaching people how to set-up, maintain and sustain home gardens using low cost, soil-building, water-wise and environmental friendly technologies. The focus is on using the limited resources available to the farmers: re-using, recycling and reducing. SFL aims to create a sustainable resource (home garden) for people that have very little and in the process help them develop skills and knowledge to give them the opportunity to create a better life for them and their families. (SFL, 2013) Pat Featherstone, Director of Soil For Life stated the following about Soil For Life's objectives: "To significantly improve the nutritional and economic status of individuals and communities through the development of human potential, whilst balancing human needs with nature's capacity to sustain life." (Featherstone, 2013)

*Organic principles: no pesticides or fertilizer and only natural compost.

Image 13: Sketch plan of Soil For Life (not to scale)

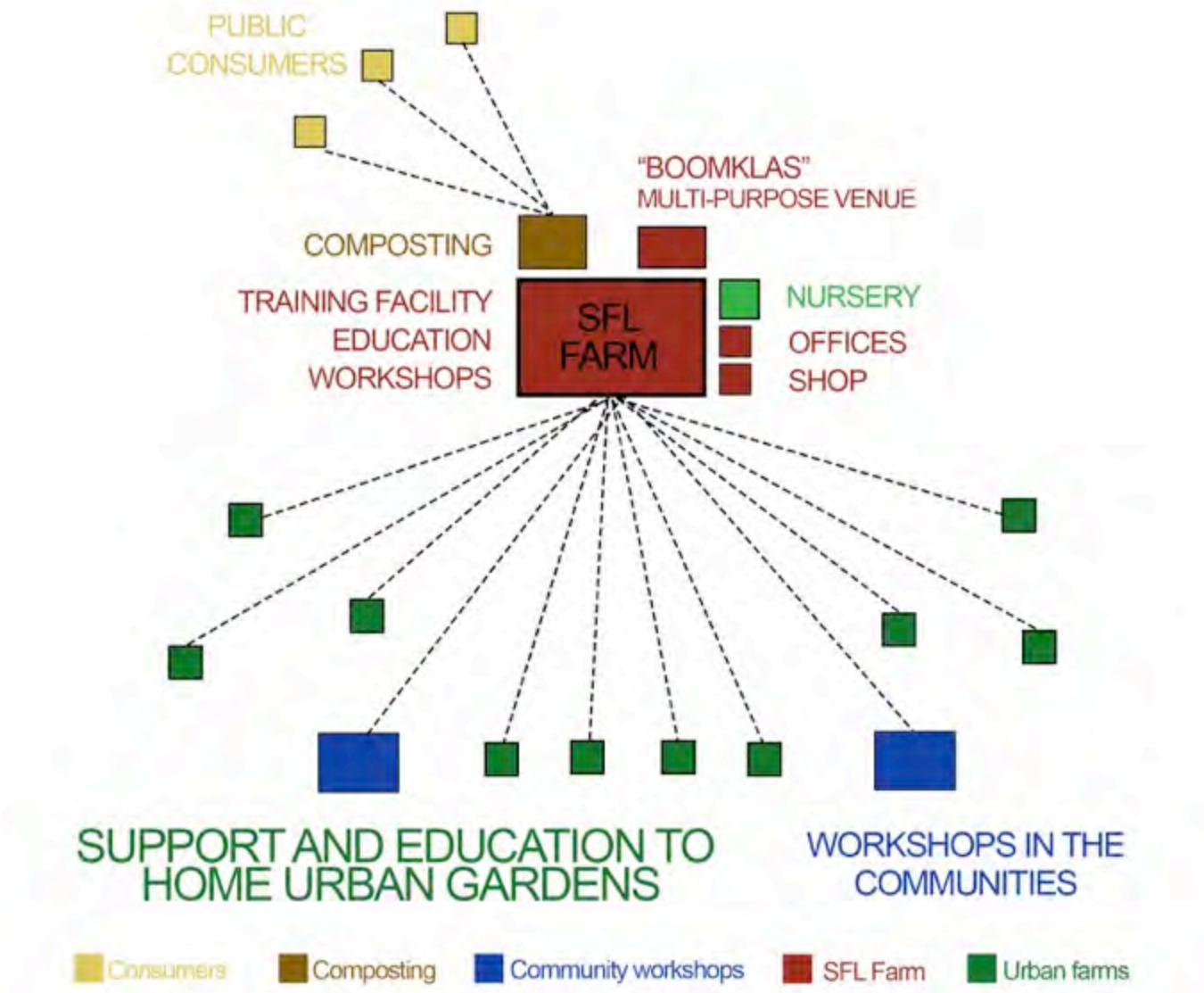


Image 14: A diagram of the SFL practice (Not to scale)

The farm is a place of training, education, demonstration and innovation. Farmers get trained, eco-schools come here as part of their curriculum, workshops take place often and the garden is filled with planting, watering and structure building examples. The site (5000sqm) includes offices, a shop, a nursery, a composting site, an earthworm farm and an indoor multi-purpose venue (open for public hire as well). Workshops that take place on the farm include structure workshops (re-using old materials and objects), herb workshops (companion planting, traditional medicine) and earthworm-, seedling-, health and well being, water-retention- and tyre-cutting workshops. Composting also takes place on the site and is sold to the public, so too earthworm compost and tea. (Fredricks, 2016)[3]

SFL runs an eleven-week home garden training and workshop course done by their trainers in the community. Training usually takes place in the morning followed by the support visits in the afternoon. The support visit is to inspect the work done in the previous week's workshop and to offer guidance if needed. The eleven-week programme includes: Seed-box and soil preparation, likes and dislikes of plants, crop-rotation, making compost, container planting, re-using materials, harvesting and seed saving. The programme includes a free starter kit containing seeds, seedlings and manure. (Fredricks, 2016)

Occasionally SFL does large workshops within selected communities in the Cape Flats. These usually take place in community halls, libraries or civic centers and include many of the eleven-week programme workshops.

[3] Fran Fredricks – Field program manager at Soil For Life

SFL is an important player in educating, up-skilling and empowering people to create their own livelihoods and to become a better person in health and spirit. “Many people who are with SFL have never had the opportunity to receive education or to pursue something personally and you can see the joy when they partake in the program and realize the opportunity it can bring” (Fredricks, 2016). These individuals become skilled farmers, with a new energy for life, able to look after themselves and their families and when the opportunity arises, they will be capable to start growing and producing on a larger scale.

The key spatial lessons extracted from SFL:

Seeing the farm as an educational and training facility, a place where demonstrations and workshops take place, where new technologies are tested and where food-growing experiments are undertaken. The workshops that take place within the community where locals are taught how to establish and maintain their own food gardens in a sustainable and affordable manner was one of the most important services provided by SFL. The ongoing support that the farmers receive from SFL also plays a vital part in the success of their urban farms.

Image 15: Soil For Life Garden at the SFL headquarters in Constantia.

Elsenburg Agricultural Training Institute

Elsenburg was established in 1898 and was the first centre for agricultural training in Africa. It is presently affiliated with the Western Cape Government to support agricultural development. The institute offers support and development through financial aid and grant funding to promote and facilitate agricultural development. They also fund new and developing agricultural projects to achieve an increase in agricultural production and enable investment in infrastructure that will enhance production. (Elsenburg, 2015)

Elsenburg works on three scales of farming; commercial, small scale and home gardens. Being the mother of all agricultural efforts in the Western Cape, Elsenburg also supports organizations such as SFL and Abalimi and their farmers. They currently roll out 100 community gardens and 1300 home gardens each year, providing mainly infrastructure, inputs, training and support. Infrastructure includes storage sheds and boreholes; inputs include equipment (small push tractors and irrigation systems), compost, seeds etc. (Conradie, 2016)[4]

It is important for farmers to have experience and access to land when applying for these services. Water is also an important factor and it is preferred to not solely rely on municipal water but rather make use of a borehole or water harvesting techniques. (Conradie, 2016)

Image 16: Elsenburg Agricultural Institute head office

[4] Adriaan Conradie – Director of food security at Elsenburg Agricultural Institute

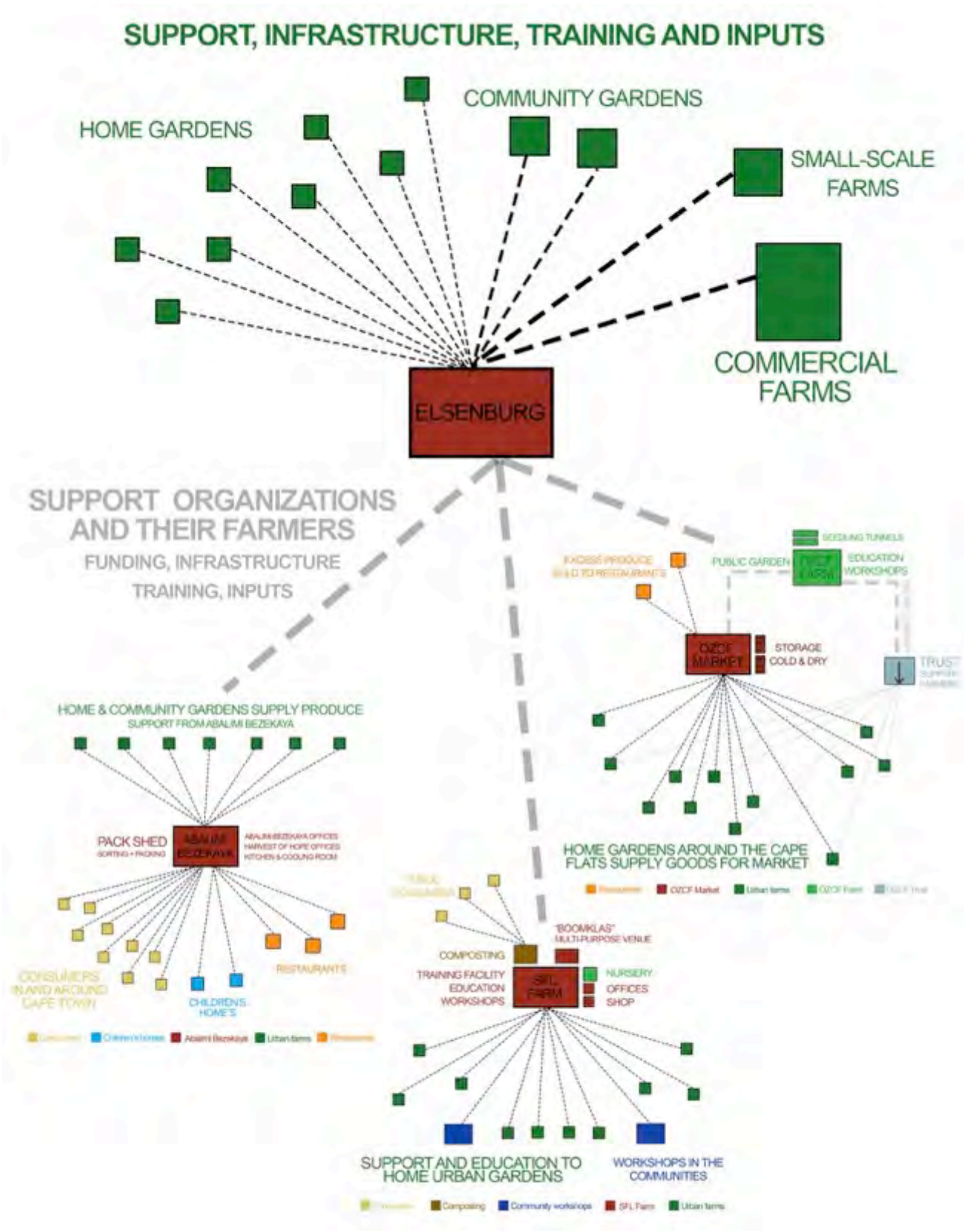


Image 17: A diagram of the Elsenburg operation (Not to scale)

Elsenburg aims to develop new and improved ways for successful and sustainable urban agricultural projects, looking at different systems (hydroponics, greywater recycling, closed water systems) as viable options to increase the success of urban farming within poor communities. They are also very important in the sense that they oversee the annual government budget for agricultural projects and need to channel the money into the right areas and projects to enable successful agricultural growth and to enhance production and sustainability of projects. (Elsenburg, 2015)

The key spatial lessons from Elsenburg Agricultural Institute:

The agricultural college informed some infrastructural requirements such as classrooms, a practical venue and a nursery where students are taught how to plant and grow seedlings. The college also has about 2Ha of land where produce can be planted and four tunnels of about 360sqm each where students receive an allocated piece of land. Lastly, Elsenburg shows and emphasizes the importance of adequate support, training, infrastructure and inputs as key to the success of any urban farm.

Conclusion

Through studying these various organizations it became clear that there is economic capability and strategy to enhance local production in order to address issues of food security. Most poor neighborhoods have labour available due to high unemployment and poverty, enough open land and a support network to grow and supply healthy food locally.

Through establishing more urban community farms and piloting bigger urban projects the mentality of farming as a rural practice can be shifted into a desired and lucrative profession. The more vacant land can be transformed from dangerous and derelict sites into money generating, food growing lands, the more we can shift the mindset of the desired urban lifestyle of the 21st century.

The local food system must be supplied through local production for it to sustain itself and for consumers and producers to benefit. As seen in Abalimi's Harvest of Hope project, the demand currently exceeds the supply and that is where I believe a bigger project could benefit and support local farmers. A project that not only increases local production capacity but also informs and educates local people to the benefits and lucrative opportunities in local food production.

The key spatial lessons I extracted by studying these organizations:

- There needs to be a centralized storage and packing component.
- There needs to be an educational and training component.
- There needs to be a retail and market component.
- There needs to be a support component.
- There needs to be an administrative component.
- There needs to be a farming component.

Most of these components can be centralized to create the heart of the operation while the farming can be dispersed where there is land available.

Land access will be important but if the economic opportunity is there and can be motivated, I believe that land can be acquired and subsidized for such a project. It could transform a community filled with unemployment, crime and malnutrition into a community filled with opportunity, networks and a new respect for the land we live on.

Local food production is the key to alleviate contemporary concerns of food security and although it might not solve the issue altogether, it is a massive step in the right direction.

- Technologies to improve food production -

The unprecedented growth of the human population and the ever-increasing growth of urbanization have begun to take its toll on the natural resources of the earth. The pressures placed on these systems are unsustainable as they are relentlessly pushed above their sustainable yield thresholds. Soon we will face a critical struggle globally as we exhaust all our resources and open land for urban living. While the world's economy is growing exponentially, nature's capacities are not and it is easy to forget that in our modern high-tech civilization, our existence is wholly dependent on these natural systems and resources. A healthy supporting ecosystem is integral to a cities survival. (Brown, 2008), (Turok, Hunter et al., 2011)

We need to turn to more sustainable ways to utilize the earth's resources while still being able to meet the demands of modern society. As land becomes scarcer, the productivity of land becomes increasingly important. Farming, once exclusively a rural practice, will have to become an urban process to produce food more sustainably and to address issues of food security present in most poor urban areas of modern cities. (Turok, Hunter et al., 2011)

There are many technologies available to increase land productivity and to help use resources sustainably. Because land is so scarce, utilizing the full potential of a piece of land and using the available resources in a sustainable manner is an essential part in establishing a successful urban agriculture operation. In this chapter I will investigate selected technologies and systems that will become integral to the success of my project.

The Borehole

Water is one, if not the most, important resource for an agricultural operation. In a country that is running out of fresh water it is of crucial importance to use this resource sustainably. The aim is to use natural resources, rain- and groundwater, as far as possible and implement technologies and systems that will reduce water usage and allow for re-using and recycling of the water.

Well points and boreholes are most commonly used to accumulate groundwater from the Cape Flats aquifer (in excess of 400sqkm) and is a stable source of water for irrigation purposes. It is not a complicated process and once installed, it can deliver an abundance of water (if the aquifer is preserved). (Hay, McGibbon et al.)

To install a borehole, you start by drilling a narrow hole into the soil, typically 150mm diameter, however the size can depend on the water requirements of the project. The depth of the shaft varies and depends on the water table of the area and again, the requirements of the project. A perforated metal casing is then inserted into the shaft. The shaft will fill up with water from the aquifer (and some groundwater) to be pumped to the surface by using a submersible pump (often electrically powered). As the water is pumped up to the surface, the shaft empties and allows more water back into the system. Water will be stored in a holding dam and will be pumped to the farms through a series of pressure pumps. (Kruger, 2015)

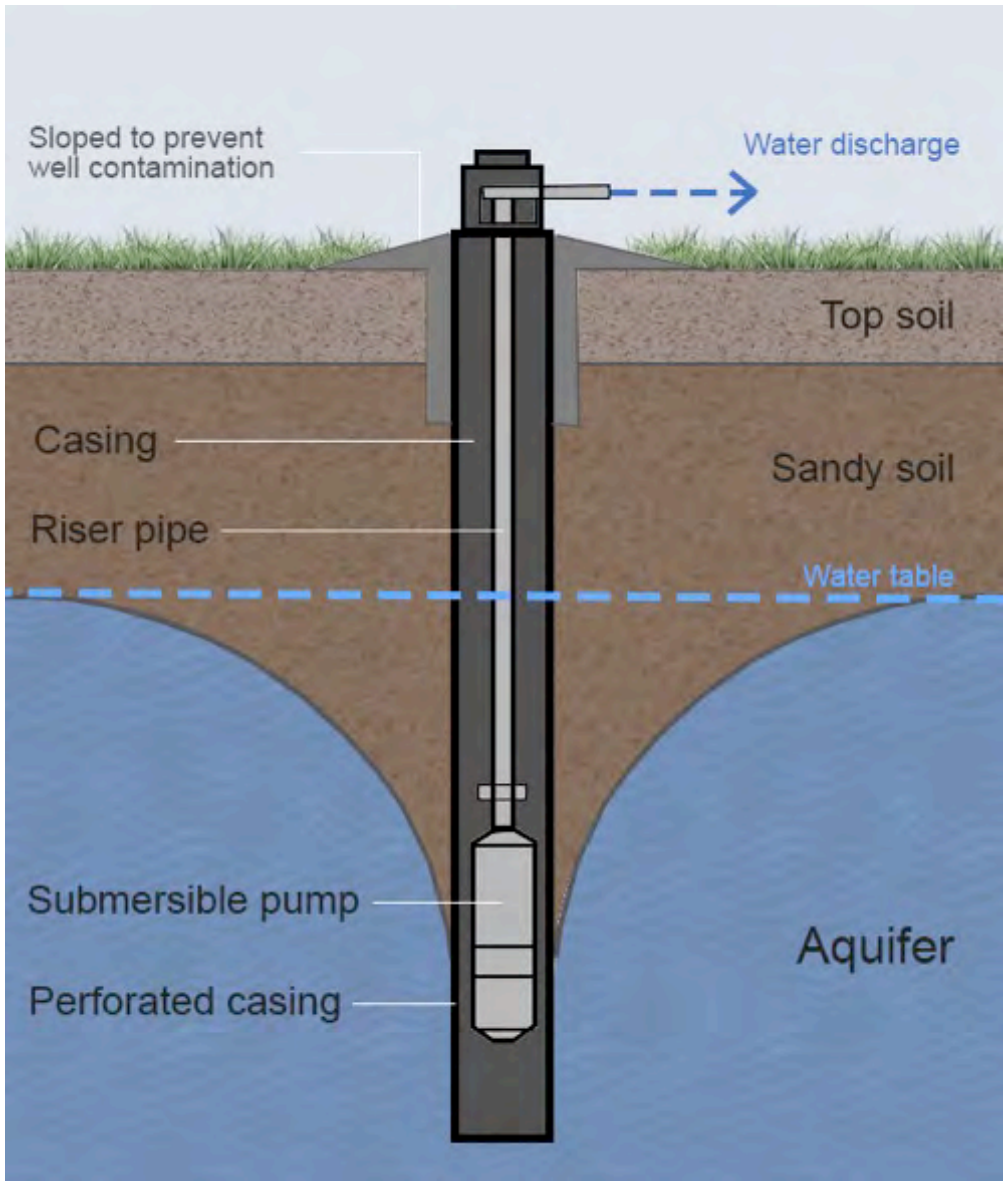


Image 18: a Borehole used to extract water from an underground aquifer.

Wind Turbines

Prevailing winds during summer come from the South and SE and in winter from the North and NW. Wind turbines will be incorporated on site and will generate energy to power, among other things, the borehole on site. Excess energy will be fed into the local grid, as there is a sub-station on site. A Wind-pump could be a more cost effective alternative to the wind turbine. However, it will not be strong enough to extract the required amount of water when irrigation reaches full capacity and would thus only be used for additional water.

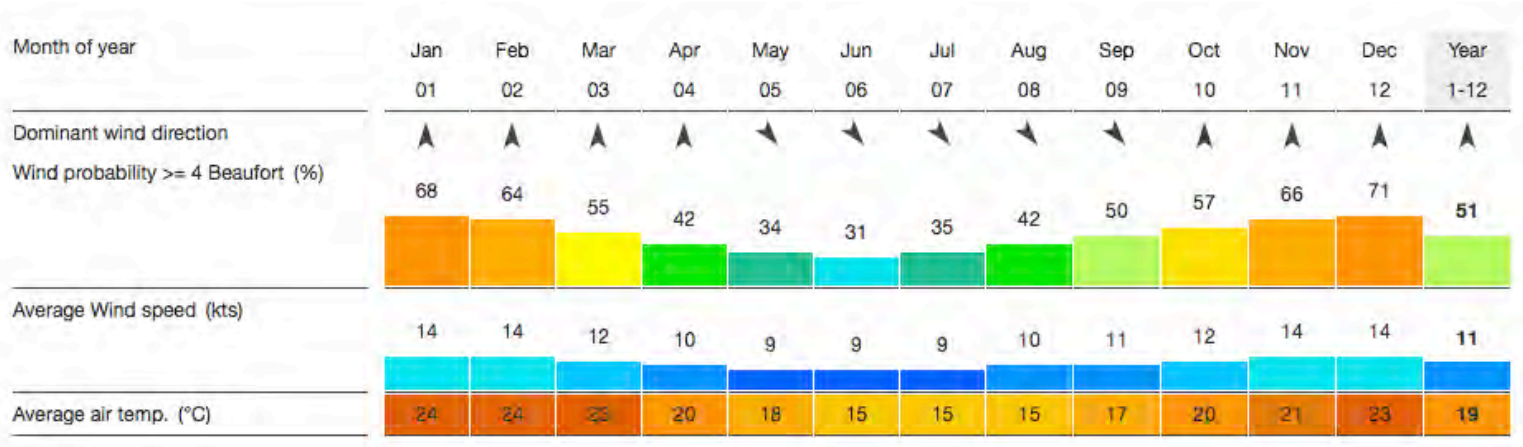


Image 19: Wind statistics for Cape Town International Airport. (Windfinder)

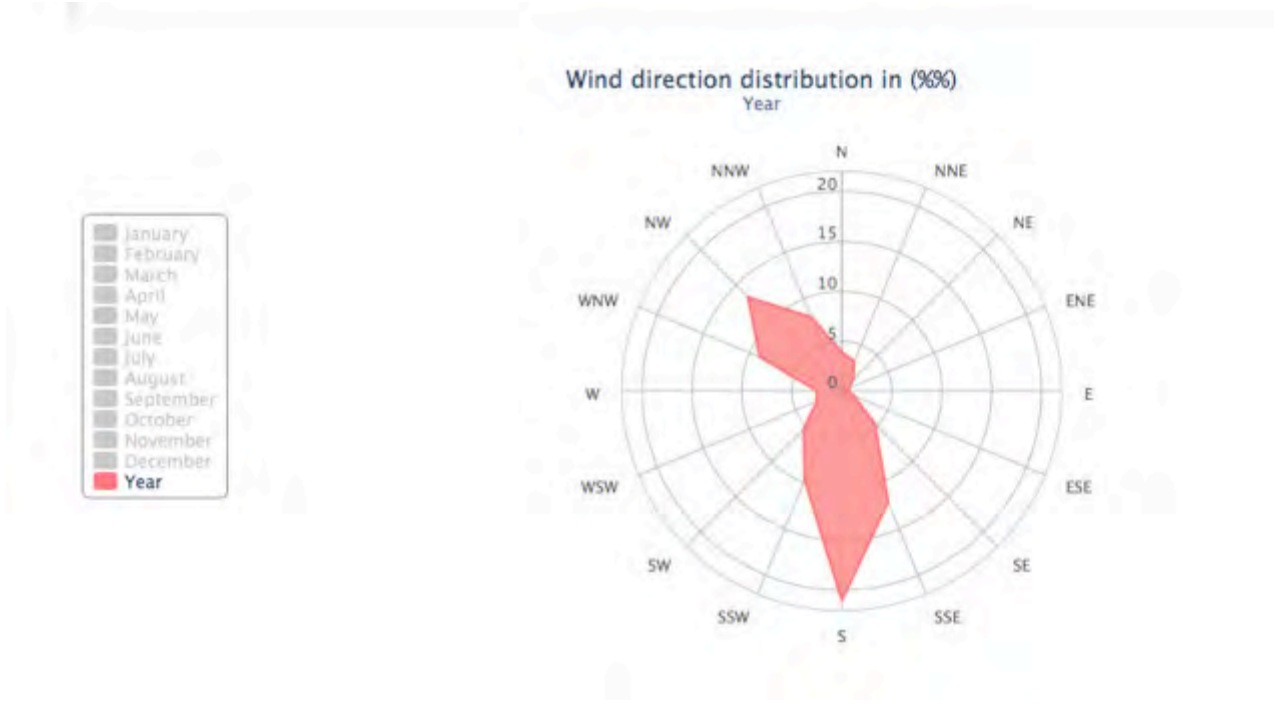


Image 20: Wind statistics for Cape Town International Airport (Windfinder)

Stormwater

Rain supplies the world with clean, potable water that in a healthy ecosystem will be recycled back into the planet and its natural cycles, but in a world that is over 60% urbanized, most of this high quality water is lost due to pollution and unproductive water management systems.

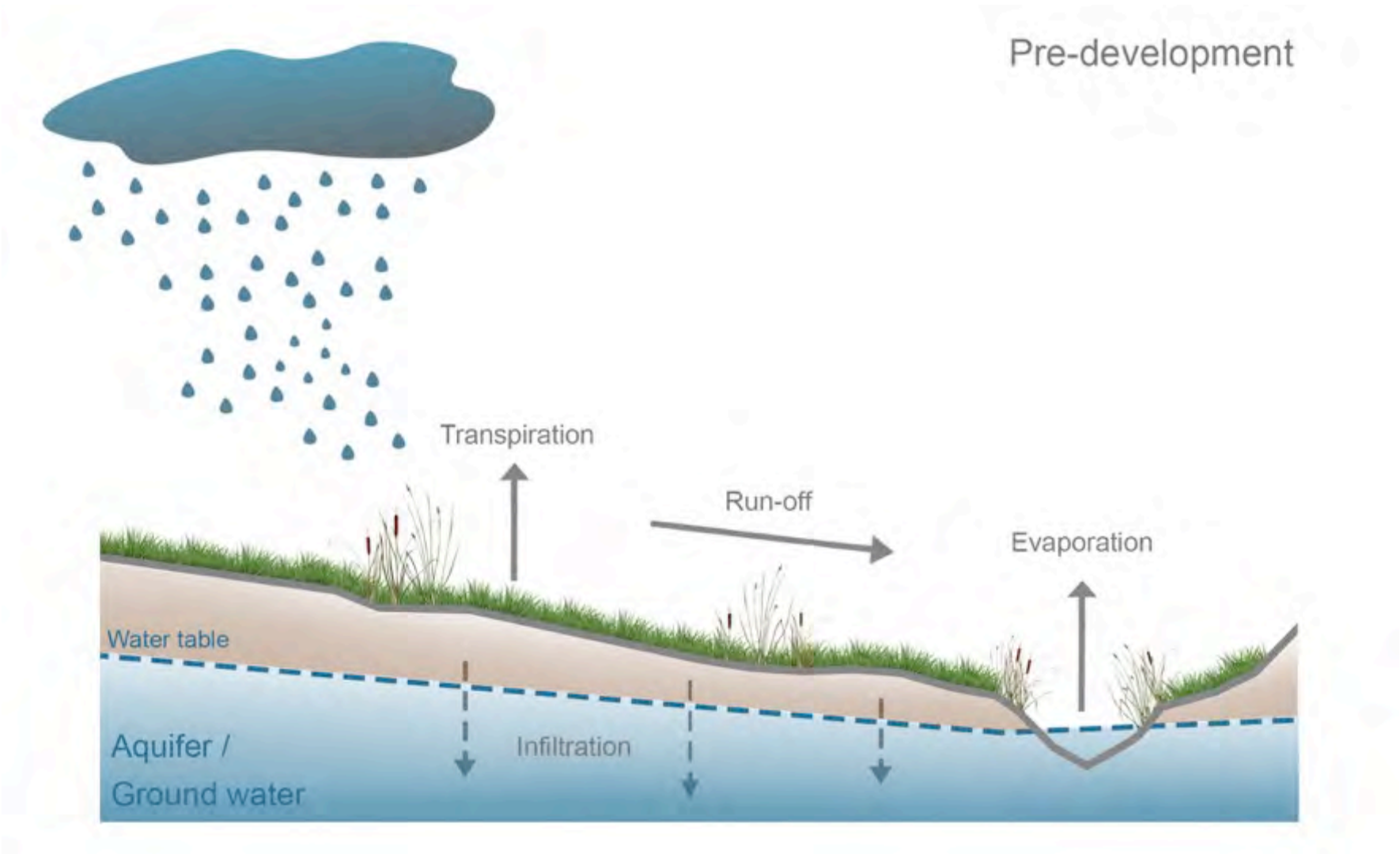


Image 21: General pre-development runoff characteristics showing the importance of efficient water management systems.

Image 21 illustrates a natural system where run off water contributes to the welfare of the natural ecology. Water filters into the ground to recharge the aquifer and groundwater, running through various plants and wetlands to clean it up. The clean water ends up in the river allowing for productive soils, healthy plants and a functioning ecosystem.

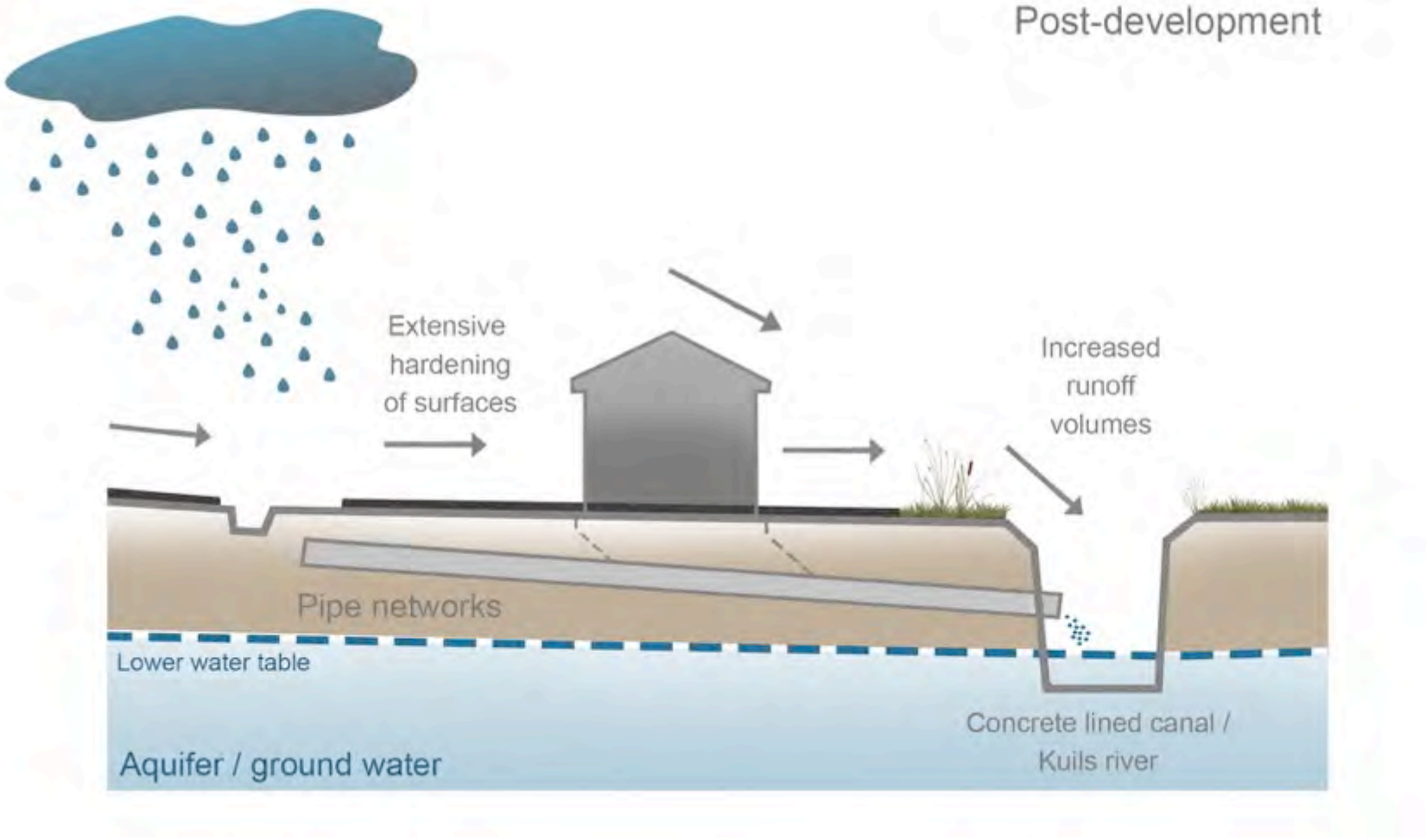


Image 22: General post-development runoff characteristics showing the importance of efficient water management systems.

Image 22 illustrates a dysfunctional natural system because of urbanization and the built-up world. Hard surfaces allow no water to infiltrate into the soil (recharge aquifer, groundwater) and all run off water flows into an infrastructural stormwater system picking up waste and pollution from the buildings and the streets. All this polluted water then gets discharged into a watercourse, negatively affecting the natural environment and ecology. Plants don't grow because there is no soil; watercourses are polluted and can't support any natural processes while a huge amount of water that could be recycled or re-used is lost. (Armitage, Vice et al., 2013)

There are various methods and technologies available to deal with storm water in more sustainable and beneficial ways. These are called Sustainable Drainage Systems (SuDS) and forms part of a bigger water strategy known as Water Sensitive Urban Design (WSUD).

SuDS deliver the best results when different systems are grouped together in the form of a treatment or management train. A good SuDS train has four components/stages:

1) Good house-keeping: Minimalize the release of pollutants, such as solid waste, into the environment where it may subsequently be transported by stormwater.
2) Source controls: manage stormwater runoff as close to the source as possible for example: green roofs, stormwater collection and reuse and permeable pavements.
3) Local controls: manage stormwater runoff in public areas such as road reserves and parks for example: Filter strips (densely vegetated grass areas), swales (grass-lined channels), infiltration trenches (excavated trenches filled with rocks), Bio-retention areas (landscapes used to manage and treat stormwater runoff through various natural processes) and sand-filters.
4) Regional controls: large scale interventions generally constructed on municipal land such as: Detention ponds, retention ponds and constructed wetlands.

(Armitage, Vice et al., 2013)

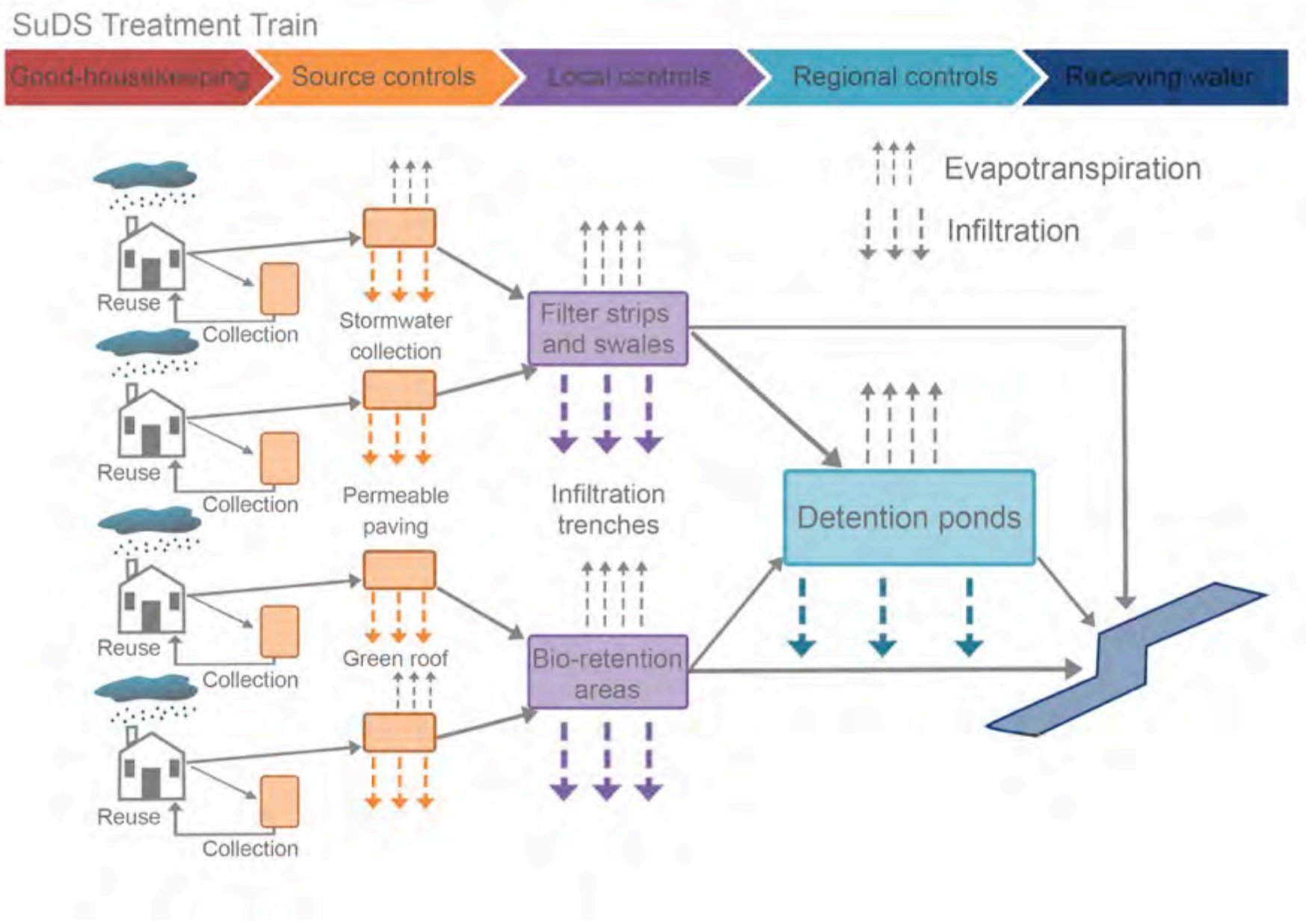


Image 23: Diagrams showing the flow of a SuDS treatment train.

Image 23 illustrates that you need to start thinking of water management at a household level first and from there, you can start looking at the bigger systems. Bringing these ideals into my projects would allow me to manage water in an architectural way, incorporating these controls from the macro level to the micro level to not impact the environment negatively and to contribute to a healthier water system.

Selected SuDS technologies to be implemented on my site include permeable paving, vegetated swales, detention ponds and storage tanks.

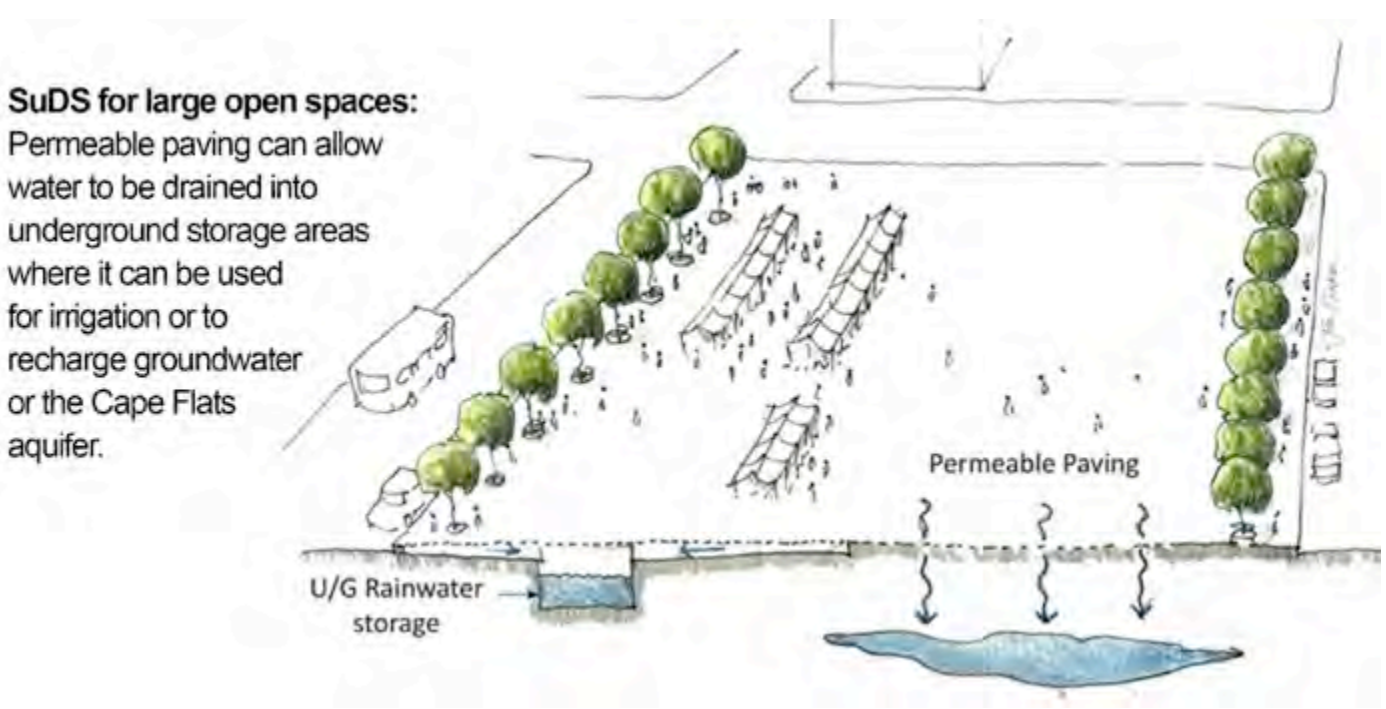


Image 24: Permeable paving can be used regularly to manage and recycle stormwater.

Hydroponics

Hydroponics is where plants are grown outside of soil in a growing medium or in water, while a perfectly balanced, pH adjusted nutrient solution is fed to the roots of the plants. The plants don't have to spend any energy searching for nutrients in the ground and can rather use that energy on vegetative growth and fruit or flower production. (SimplyHydro, 2008)

There are many advantages to hydroponic growth, but most importantly, it gives plants the ability to grow as healthy as genetically possible. To do this in soil is far more difficult as soil is exposed to many factors that influence its quality and growing capabilities. Hydroponics allows you to feed the plant the nutrients that it needs, in the right amount at exactly the right time, allowing for maximum productivity. There are various growing mediums that include sand, gravel, vermiculite, perlite and coco peat (an organic multi-purpose growing medium). (SimplyHydro, 2008)

Hydroponics guarantees faster growth, higher yields, much lower water usage (about 1/20th of traditional soil based gardening), water recycling, less space to grow, no seasonal limits and the vegetables and fruits usually has higher nutrient value. (Olivia's solutions, 2013)

The following two water-based systems will form a hybrid system to be used in my seed laboratory to guarantee optimal plant growth. During the wet winter months the plants will grow while floating in nutrient rich water while in the dry summer months, the plants' roots will be flooded with the nutrient rich water.

> The Water Culture system is a very simple hydroponic system where the plants are held in Styrofoam platforms that floats directly on nutrient rich water. An air pump supplies oxygen to the roots of the plants. (SimplyHydro, 2008)
>
> Nutrient film technique has a constant flow of nutrient solution so no timer is required for the pump. The solution is pumped into the tray, flowing over the roots of the plants and then back into the holding tank. The plants are usually supported in small plastic containers with their roots hanging into the nutrient solution. (SimplyHydro, 2008)

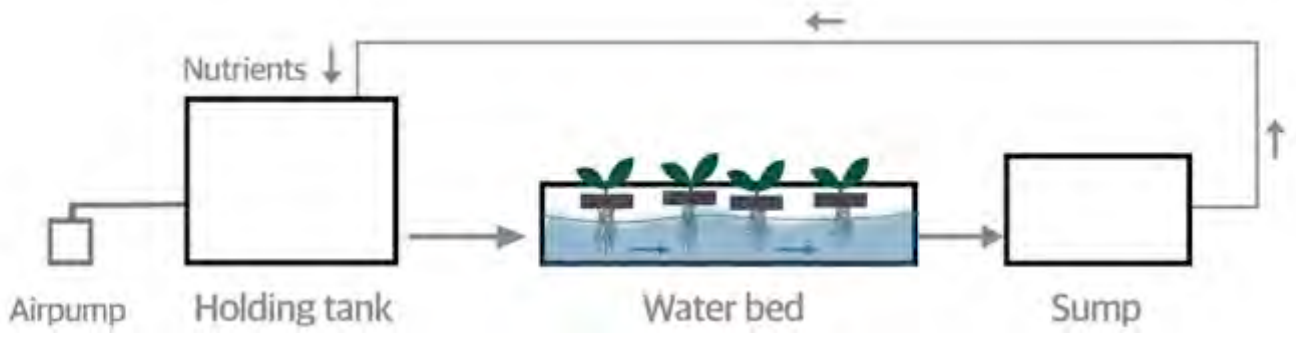


Image 25: A diagram for the Water Culture system and the Nutrient Film Technique. The system could be designed to function as a hybrid system optimally during dry and wet seasons.

The Drip system is most widely used around the world and will be used in my greenhouse. A timer controls a pump that pumps nutrient rich water into thin pipes where it drips down onto the plants. (SimplyHydro, 2008)

The Ebb and Flow system works by temporarily flooding the growing tray with nutrient solution and then letting it drain back down into sump. Nutrient rich water then gets pumped back into the growing tray as needed with help from a timer. (SimplyHydro, 2008) When incorporating it into an aquaponics system, the fish will supply the nutrients in the water for the plants to take up.

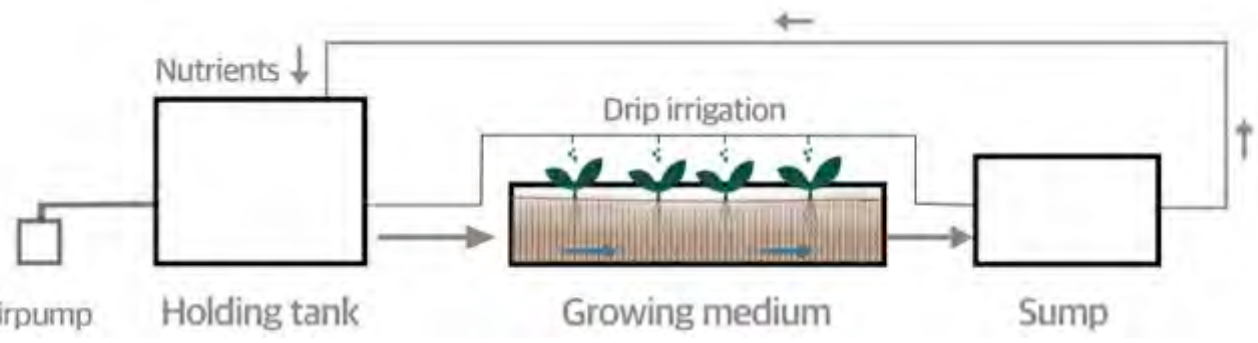


Image 26: Diagram for the Drip System. The Ebb and Flow system follows the same logic except the growing tray gets flooded every 7-10 minutes.

Aquaculture

Aquaculture is the commercial farming of fish for human consumption. In my project, it will be done on land in a controlled environment. The fish are grown in tanks and are fed artificially. The running of an aquaculture farm consists mostly around the managing of water quality as once the farm is set up the most important aspect is to keep the water clean. A typical aquaculture system consists of a fish tank, a solids filter, a bio-filter and a sump. You can either end the system where you discharge or channel nutrient rich water into the land or you can create a closed loop system where you incorporate the growing of plants. (Flemming, 2016)[5] I will consider implementing both systems to support various aspects of my agricultural operation.

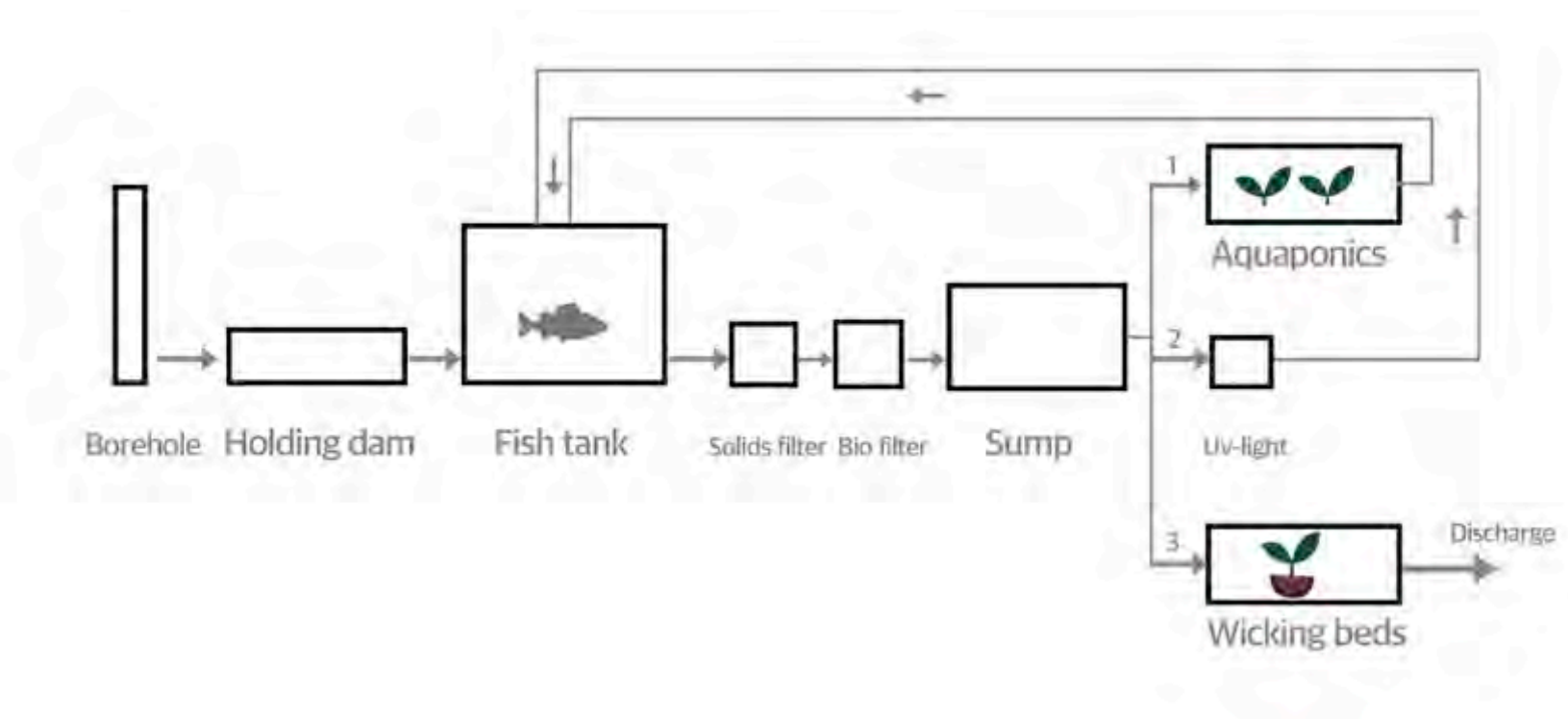


Image 27: A basic aquaculture setup with three different end scenarios

[5] Alan Flemming – Founder of The Fish Farm

Aquaponics

When fish live in a natural environment, such as a pond, a self-sustaining cycle would form as the plants and algae grow food for the fish while the fish produce nutrient rich waste for the plants. These are the basic principles of aquaponics.

Aquaponics combine aquaculture and hydroponics into one integrated and self-sustaining system. There are three main components – Fish, plants and microbes. The fish produce waste that serves as an organic food source for the plants while the plants provide a natural filter for the water before it is pumped back into the fish tanks. The microbes (bacteria) are a very important element in that they convert the ammonia from the fish waste into nitrites and then into nitrates that feeds the plants. (Backyard aquaponics, 2012)

What makes Aquaponics such a desirable and successful system is that it turns the negatives of both Hydroponics (expensive nutrients) and Aquaculture (removal of excess nutrient rich water to be replaced with fresh water) into positives while retaining the advantages of both systems. (Backyard aquaponics. 2012)

Aquaponics can produce significant fish and vegetable yields in a short amount of time as fish and plants can be grown densely using less water then traditional soil growing, mostly because of the water recirculation.

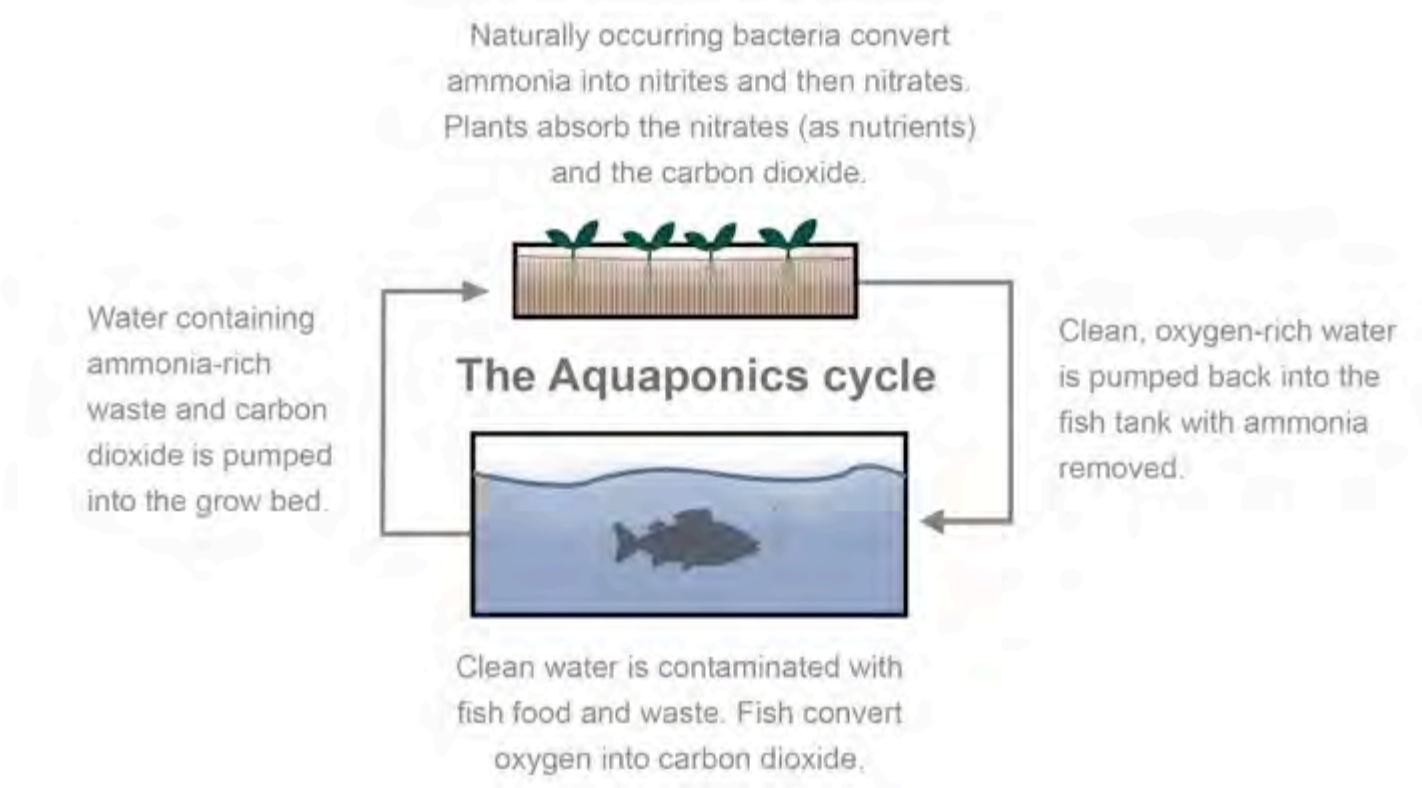


Image 28 Top: The Aquaponic cycle - worms can also be present in the growing medium.

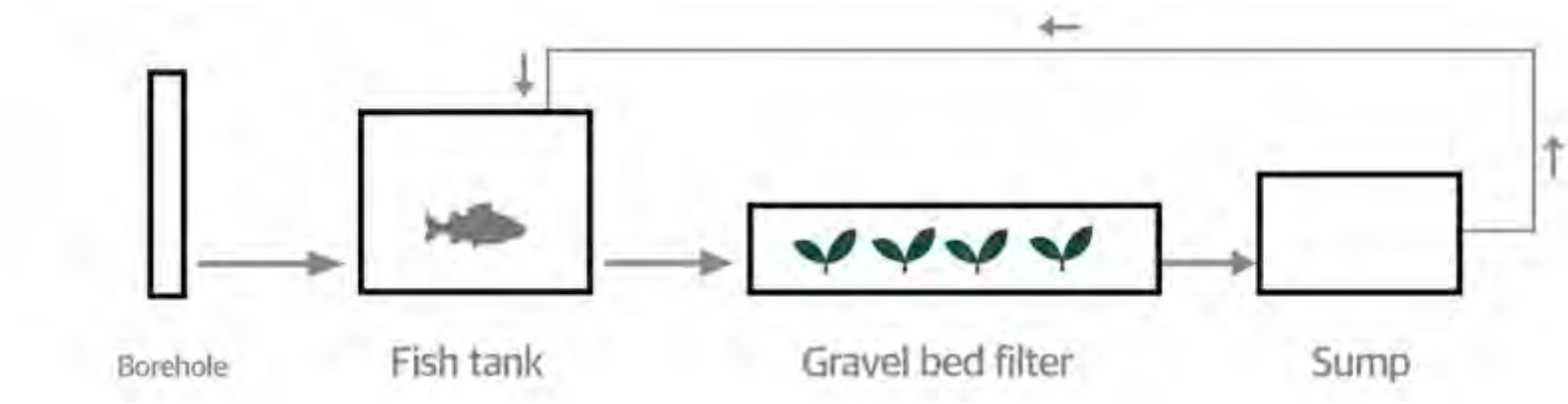


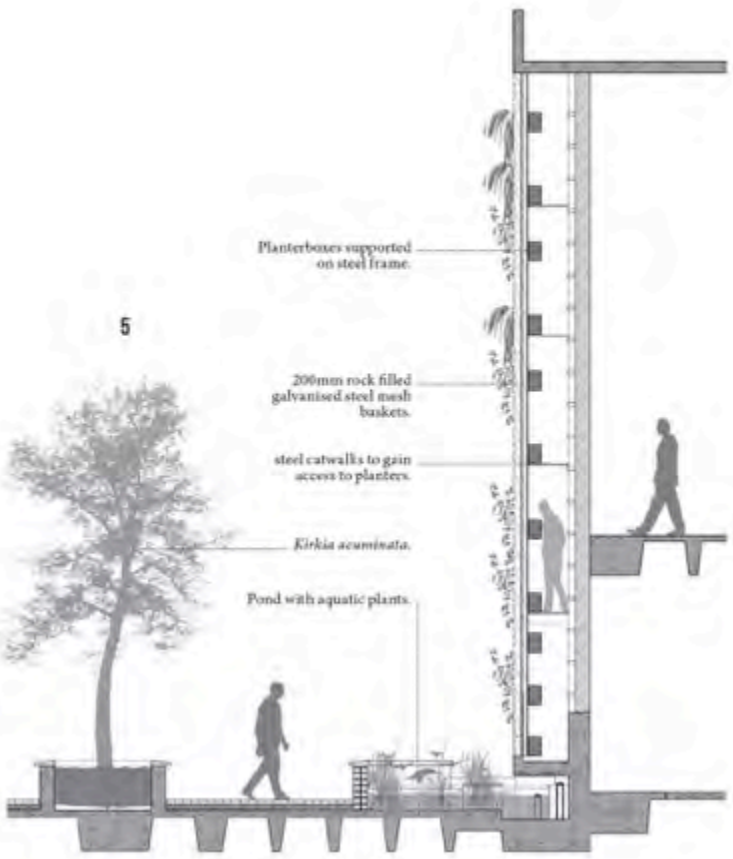
Image 29: A basic aquaponics setup. Note: the amount of gravel beds can increase for one fish tank.

Vertical farming

In an urban world, where densities of housing is increasing daily, it is important to be able to utilize small spaces to produce food. Vertical farming has become a very space sensitive way to grow food, requiring minimal footprint on the ground to generate a substantial yield. As we explored previously, hydroponic systems can be used in vertical farming by arranging and stacking the growing beds or pipes above each other. In the contemporary world, architects have even started to integrate vertical farming into buildings interiors and facades as part of a more sustainable way of living (and building) in the 21st century.

There are a number of ways to do vertical farming, the most common being stacked beds and living walls from which plants are grown. The farming usually happens under controlled circumstances such as a greenhouse while the living walls usually forms part of a buildings façade. Because vertical farming requires a lot less space than traditional soil based farming, it is designed for urban integration.

When integrating vertical farming into building façades and interiors it can contribute to improved thermal, air, acoustic and aesthetic conditions while improving building energy performance.



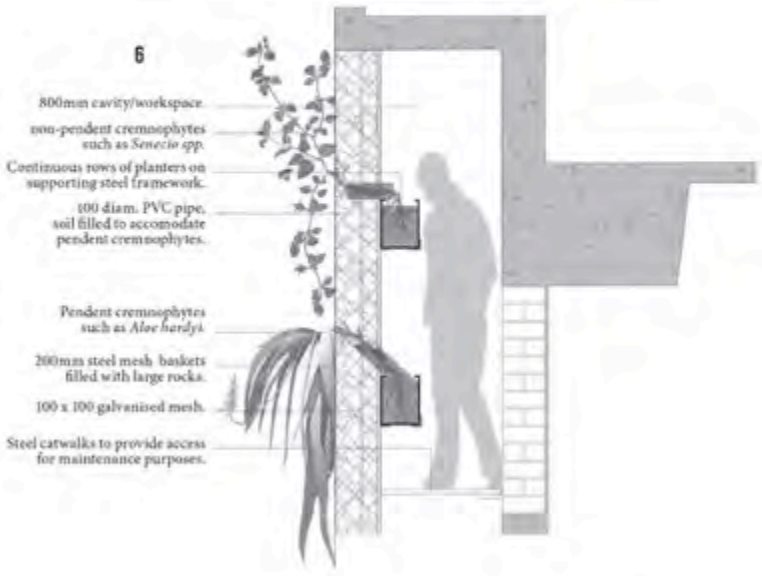


Image 30 Top Left: Section through the rock-filled living wall at the UP Plant Sciences building at the University of Pretoria

Image 31 Bottom Left: Detail section through the Rock-filled living wall at the UP Plant Sciences building at the University of Pretoria

Image 32 Top Right: Rock-filled living wall at the UP Plant Sciences building at the University of Pretoria

Earthworm composting

Vermicomposting is one of nature’s very own miracles, an organic system to recycle waste and produce some of the richest fertilizer known to man. It is very easy: you need a container/s (old bath, plastic or concrete bed), some soil and lots of earthworms. Then all you do is recycle your organic kitchen waste such as vegetable peels, old fruits, eggshells, tea-bags and even newspaper and cardboard (no plastic, meat or oily foods) and feed it to the worms. They eat the scraps and it becomes compost as it moves through their bodies. Along with the compost, you also get extremely nutrient rich liquid called worm tea. As waste is broken down, moisture filters through the worms, dragging nutrient-rich particles with it. This liquid fertilizer can be mixed with water to feed your plants. You can also mix the compost with water to create a highly fertile liquid for your plants. (Fong and Hewitt, 1996)

You can stack the containers if you need to save space. The worms work their way up naturally when they have exhausted the bottom tray and in the process separate themself from the finished compost. Vertical separation is the most convenient way to separate the worms from the compost and it can be done with mesh screens or something similar. (Worm Factory, 2009)

In a place like Delft, where soil is unfertile, vermicompost would be a great asset for enhancing soil-based food production. It would also be used in the greenhouse and be sold to local farmers. It is also a great way to recycle food waste back into the earth.

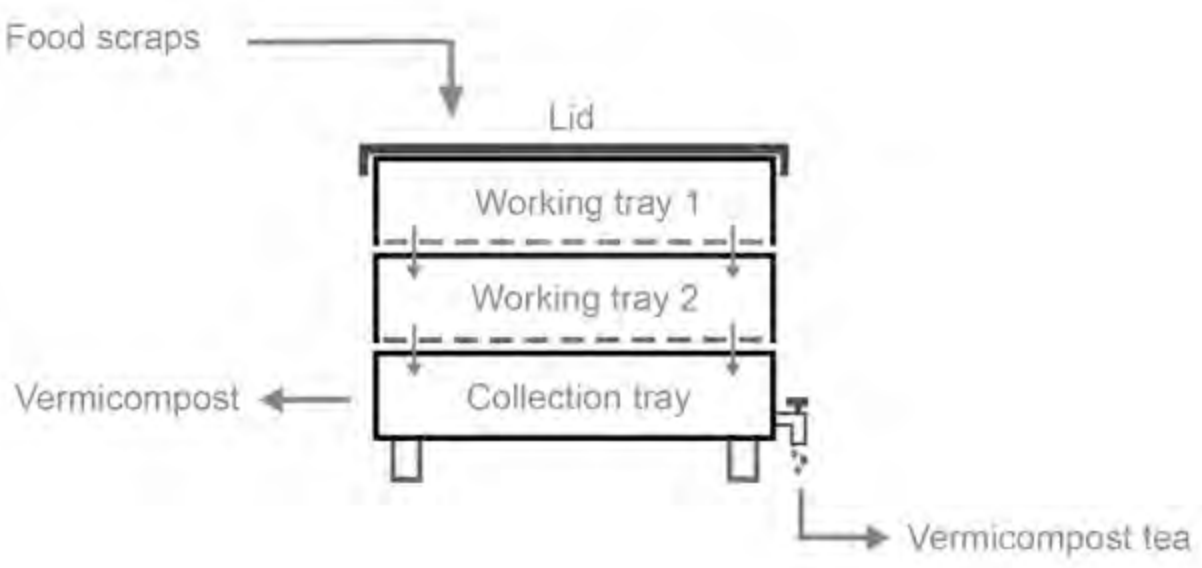


Image 33: A standard worm tray configuration with vermicompost tea outlet.

Image 34 (left) & 35 (right): Earthworm farm at Elsenburg Agricultural Institute

Anaerobic Digestion

A biogas reactor or anaerobic digester is an anaerobic treatment technology that produces digested slurry, that can be used as fertilizer, and biogas, that can be used for energy. The airtight reactors are placed under the ground and filled with animal manure, kitchen and garden waste and blackwater from toilets where it decomposes in absence of oxygen and with relatively high moisture levels. The organic waste is turned into biogas that can be used for cooking, lighting and heating. The gas forms in the slurry and collects at the top of the chamber. As the gas is generated, it exerts a pressure and displaces the slurry upward into the expansion chamber. This is called the digestate, a nutrient rich sludge, can be accessed from above ground and is used as a fertilizer. The pressure from the rising gas can be used to transport it to where it is going to be used. (Spuhler, D. and Eawag. 2014)

Anaerobic digestion is a low capital investment with low operating costs that makes it a great choice for areas where high amounts of waste needs to be dealt with. It doesn't require any electrical energy, it can be built and repaired with locally available materials and it treats all human, animal and solid organic waste together while creating valuable resources such as biogas and fertilizer. (Spuhler, D. and Eawag. 2014)

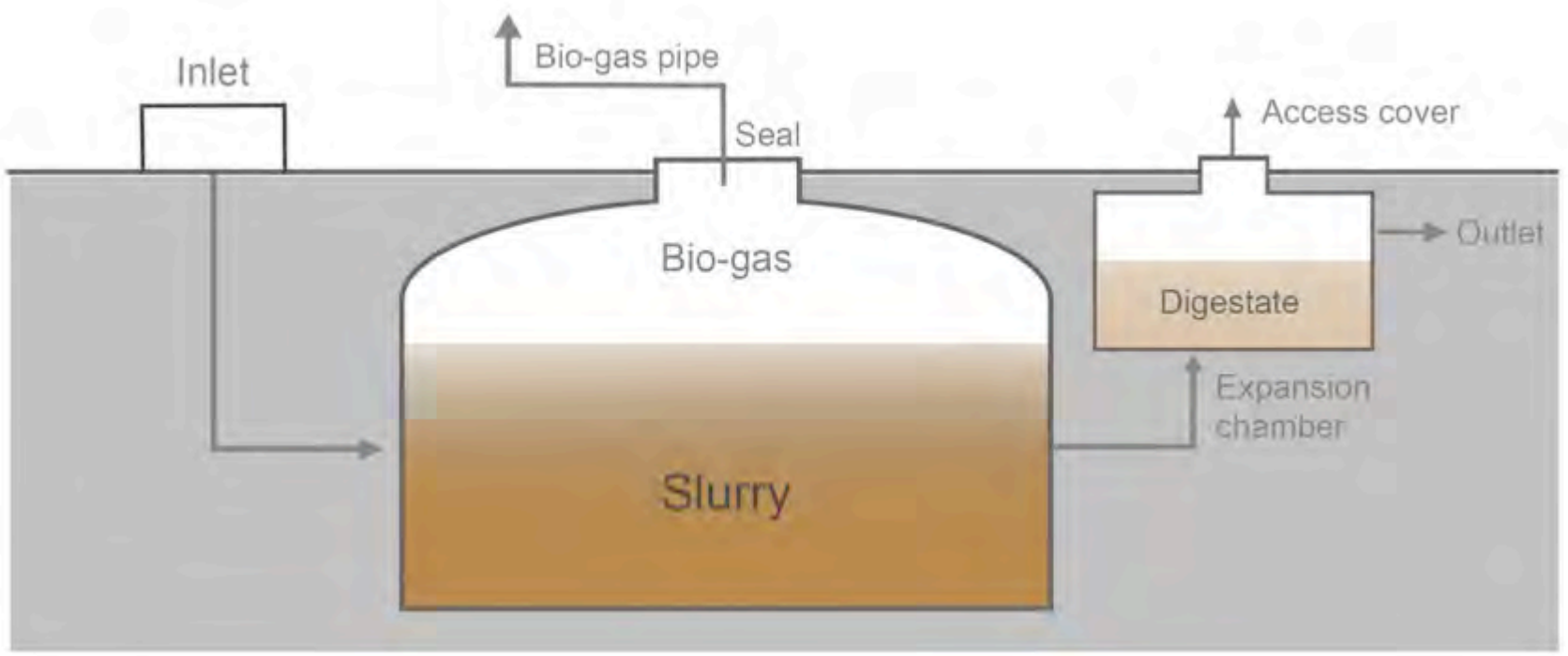


Image 36: Schematic of a biogas reactor

Greenhouse

A greenhouse creates a controlled environment where plants are protected from the elements allowing farmers to grow them to the best of their capabilities. The changing seasons - temperatures, rainfall, soil erosion and winds can all be controlled in a greenhouse. The microclimate created inside the structure allows farmers to extend the growing season of plants that would not thrive in the colder climate outside, enabling farmers to produce food locally (where it usually would have been imported) out of season. (Edwards, 2015)

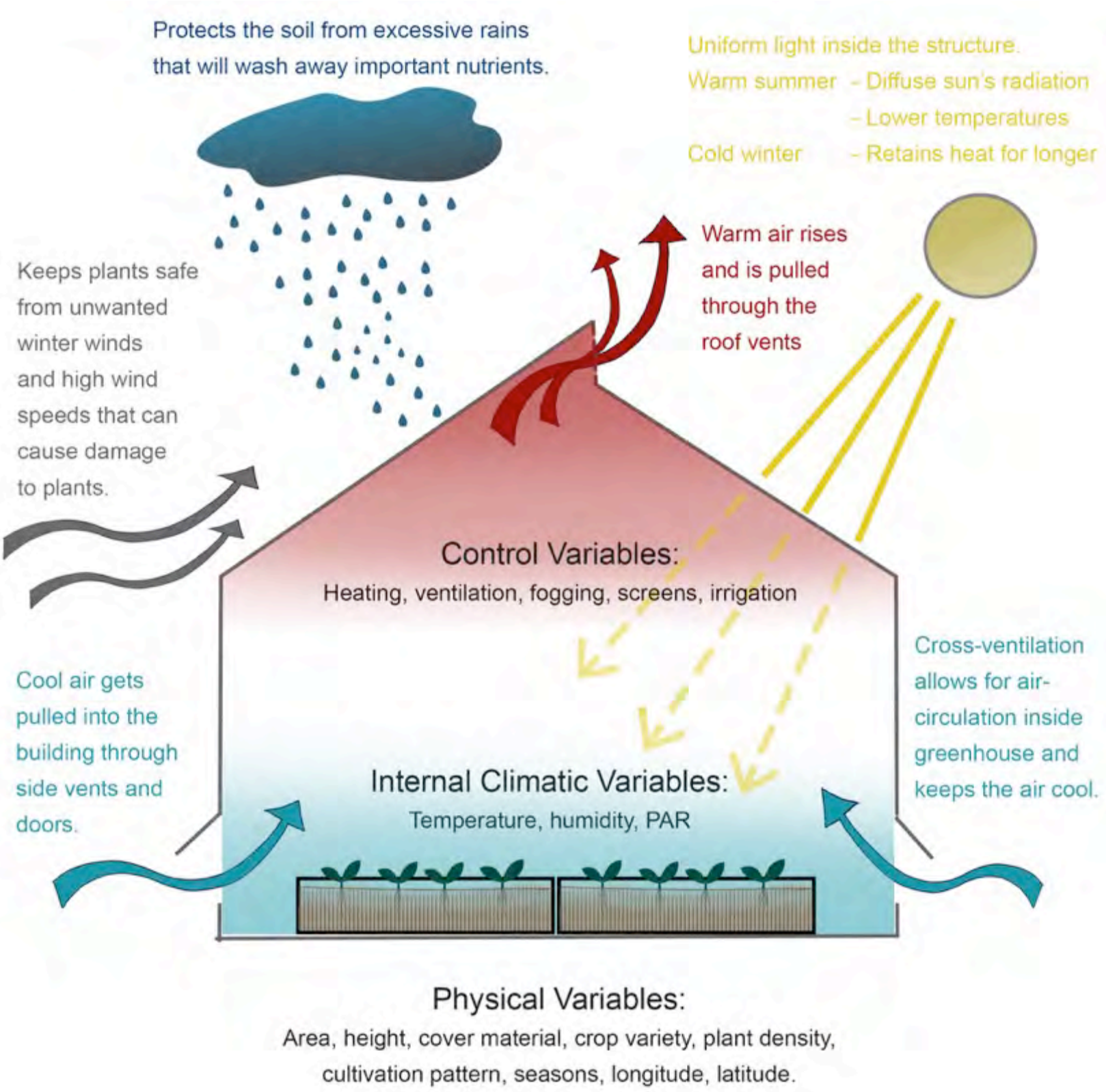


Image 37: Illustration of a greenhouse, the external forces and all the variables you can control.

Greenhouses are a technology based on investment; the higher the level of investment the more control you have over the growing conditions. The capacity to control the growing environment is strongly related to the health and productivity of the crop.

- Low technology greenhouses are usually less than 3m in height and made up of a net-like material. They have poor ventilation, no vertical walls and are relatively easy and inexpensive to erect.

- Medium technology greenhouses are typically characterized by vertical walls between 2m and 4m tall and a total height of 5.5m of less. There may be roof or side ventilation (or both) with various degrees of automation.

- High technology greenhouses usually have a wall height of over 4m (the optimal height) with the roof peak around 8m from the ground. These structures offer superior crop and environmental performance and include side and/or roof ventilation. Plastic film, polycarbonate sheeting or glass may be used while environmental control is almost always automated.

Greenhouses should typically face North-South (Southern Hemisphere) to maximize natural light but depending on the region could differ slightly as cooling and ventilation should also be considered for the final orientation. The direction of prevailing winds should be taken into consideration for structures to take advantage of cooling summer breezes.

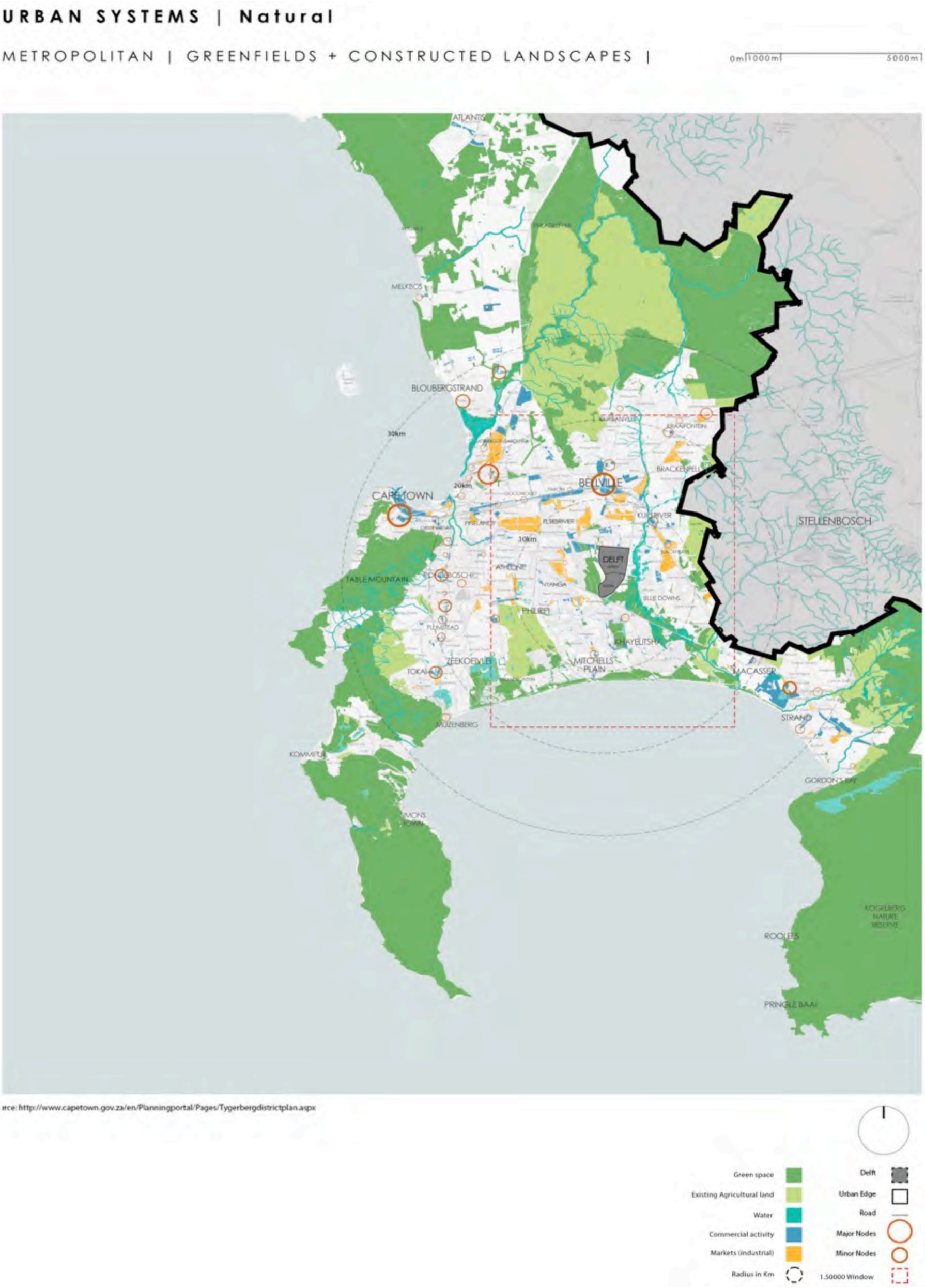
The covering material for the greenhouse should be carefully considered by evaluating the cost, its durability, its weight and ease of repair or replacement, how much light is transmitted through the material and how much energy moves through the material. Glass remains the traditional covering because of its favorable properties that include good heat retention, durability and low maintenance cost.

Ventilation and air-circulation is critical in maintaining an optimal growing environment, increasing plant activity and reducing the chance of diseases. The most common type of ventilation is passive roof ventilation. Openings (vents) in the roof draw air through the greenhouse allowing hot air to be drawn out through the roof. Air-circulation is achieved through effective ventilation and it is recommended to have a tall structure for effective cooling, while a fogging system is often used to keep air cool and humid.

During the cold winter months, temperatures can drop dangerously low and the greenhouse needs to be heated to maintain growing temperatures and plant health. Heating of a greenhouse is usually achieved through boiling hot water, usually with gas, and distributing the hot air evenly through a pipe system.

High-tech greenhouses can be expensive to erect but offer enormous economic opportunities by creating a highly productive environment for growing specialized crops with no seasonal limits. It is also environmentally sustainability with the use of pesticides greatly reduced.

(NSW Department of Industry, 2016)



rce: http://www.capetown.gov.za/en/Planningportal/Pages/Tygerbergdistrictplan.aspx

Image 38: Locating Delft in the Cape Metropolitan region

Delft is a neighborhood established in the late 1980s on the outskirts of Cape Town. It is situated about 30km from the city center towards the eastern edge of the Cape Metropolitan region and forms part of the Cape Flats. Most neighborhoods in the Cape Flats are low-income neighborhoods where the majority of people live in poverty. Issues of food security are very relevant and evident in these neighborhoods. At first glance these areas are not considered favorable for growing food as greenery is scarce and soil appears unfertile. However, there are some successful cases of agricultural growth and upon closer investigation it became evident that urban agriculture was not only possible but rather, plausible.

To establish productive land in a suburb such as Delft it is important to understand its agricultural potential and the quality and availability of natural resources. The objective is to understand and then improve the current conditions for growing food while putting less pressure on the existing natural resources. By doing this we can create a much more sustainable form of urban agricultural production resulting in a more resilient neighborhood and a healthier environment.

Water Sources

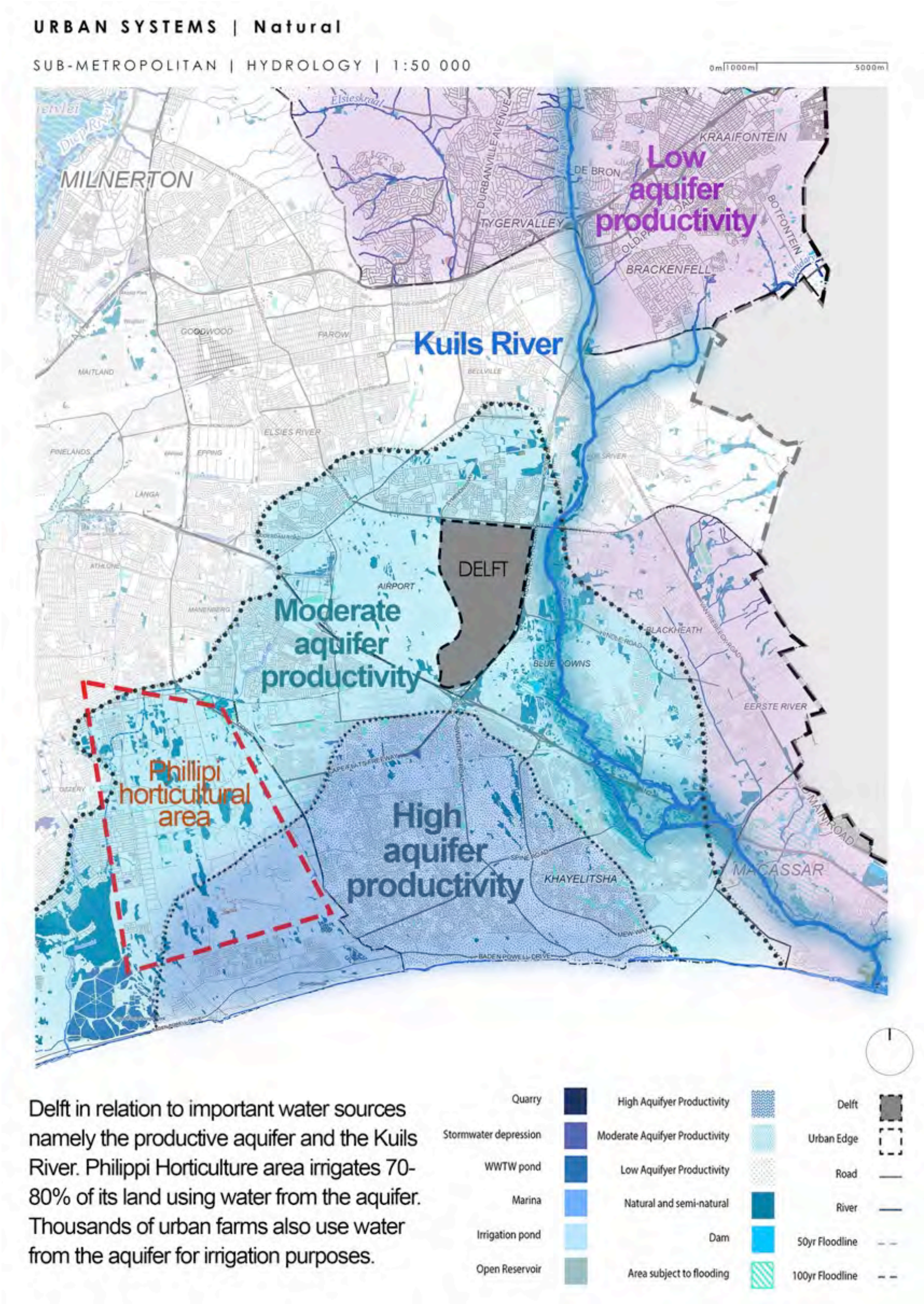


Image 39: Locating Delft in relation to natural water resources

The Cape Flats aquifer (in excess of 400sqkm) lies underneath most of the Cape Flats and is a stable source of water for irrigation purposes. Well points and boreholes are most commonly used to accumulate groundwater from the aquifer, while in Philippi, storage ponds were created to catch rainwater and to hold the groundwater. (Hay, McGibbon et al.)

To use the underground water, it would possibly have to go through a filtering process that could require subsidies. Presently, there are many urban farms and community farms that use the aquifer as the main water source and according to Elsenburg Agricultural Institute the groundwater from the aquifer is sufficient for irrigation purposes. (Conradie, 2016) Testing would be done on site to make sure the water quality is at an acceptable level. There are also many ways to clean water naturally such as aquaculture systems and natural filters, swales and wetlands.

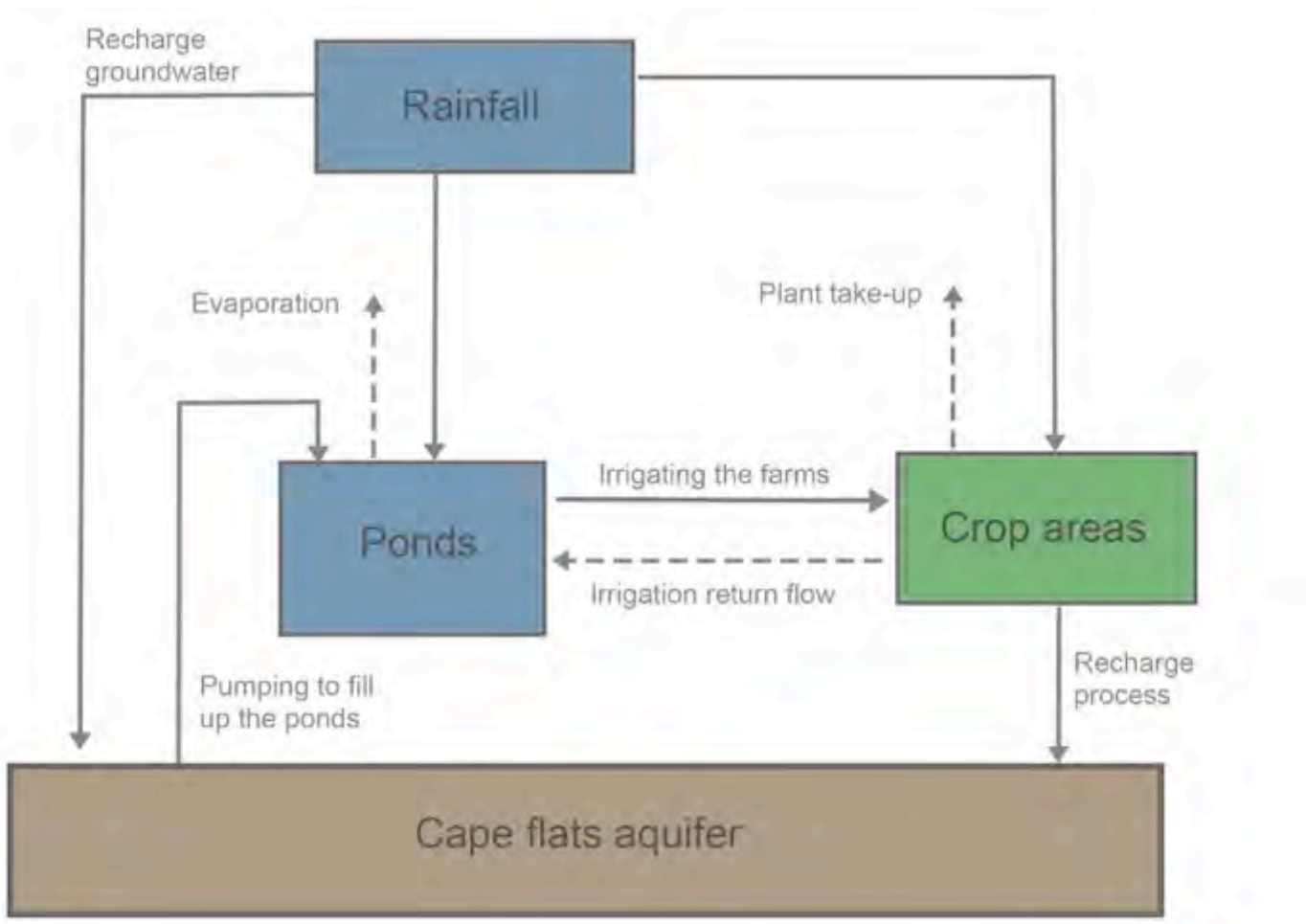


Image 40: a Diagram showing how the ponds and the aquifer are used for irrigation in the Philippi Horticultural Area. Note the ponds catch significant rainfall in winter but in the dry summer months, water is pumped from the aquifer into the ponds.

Water is one, if not the most, important resource for an agricultural operation and in a country that is running out of fresh water sources it is of crucial importance to use this resource sustainably. The aim is to use natural resources, rain- and groundwater, as far as possible and to implement technologies and systems that will reduce water usage and allow for re-using and recycling of water as far as possible.

Delft receives an average rainfall of 475mm per year, the majority of that during winter. The summer months are warm and dry (average daily temperature of above 25 degrees Celsius) while winter is cold and wet (average daily temperature of below 19 degrees Celsius). During summer, water will need to be sourced mainly from the ground while water reticulation will also play an important role. (www.cape-town.climatemps.com, 2015)

Optimal water use and water management became big drivers in my design. This has driven me down the road of hydroponics, aquaponics, aquaculture, water treatment, underground water distribution and whenever I cant recycle or reuse the water, it gets drained into the ground to recharge the aquifer.

Bio-Diversity

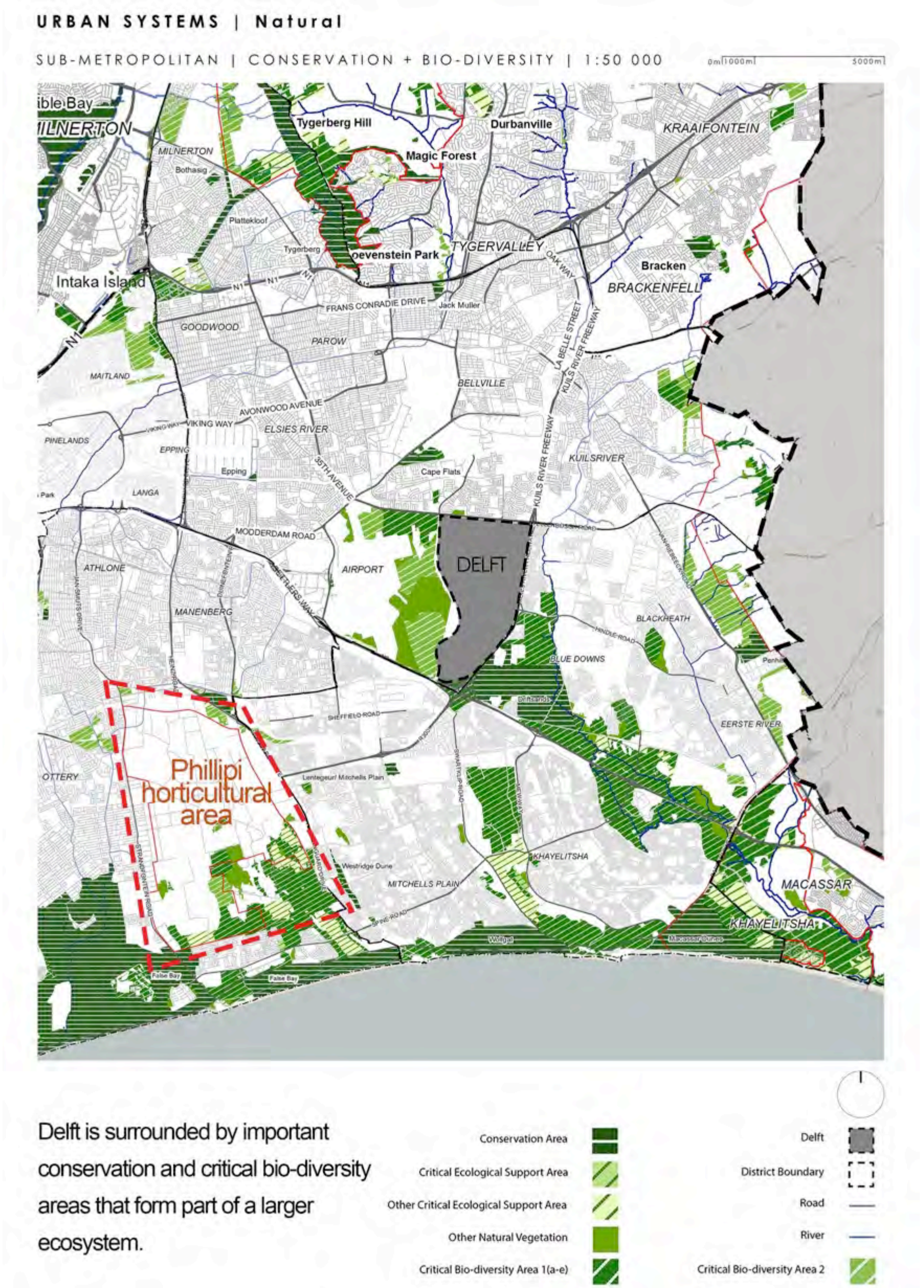


Image 41: Locating Delft in relation to bio-diversity and conservation areas

Bio-diversity and conservation areas form part of a bigger ecological system that is really important to preserve. Our ecosystem is under serious strain as urbanity is disrupting and destroying natural habitats. It is of vital importance to protect and reintroduce nature to preserve our natural environment, something the Cape Flats was well known for not so long ago. Many species of wildlife, plants, birds and insects used to live on these lands, and through preserving these areas and introducing nature back into these urban environments, we can once again create and boast a healthy natural ecosystem.

Soil Conditions

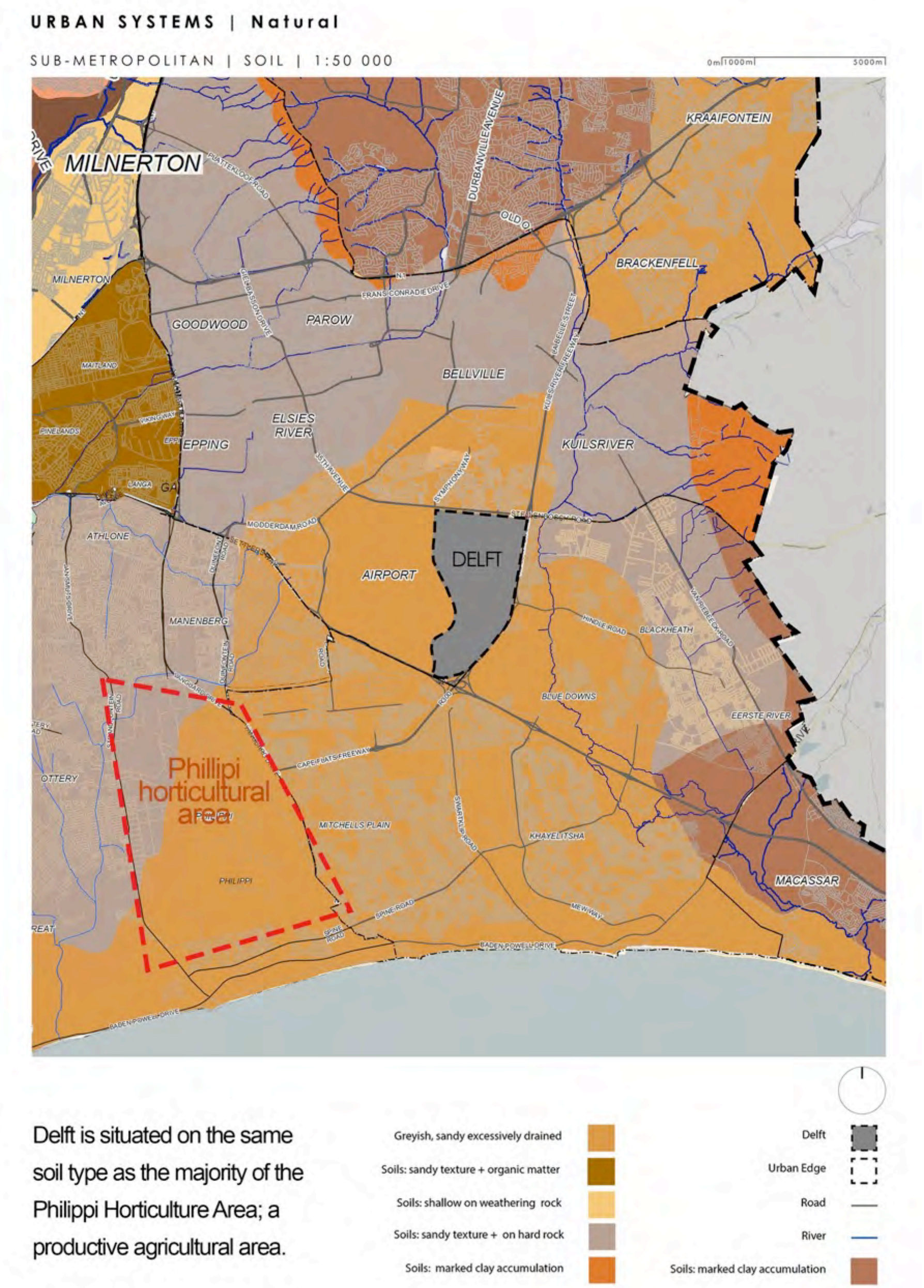


Image 42: Soil conditions in the Cape Flats area

Delft, historically a landscape of dunes, consists primarily of unconsolidated, excessively drained sandy soils. (MLH, 1987) This means that it lacks some important qualities to be classified as good soil for agriculture. Sandy soils lack density to hold any water or moisture, essential for healthy and fertile soil. No organic matter can live in the soil to supply the plants with the nutrients it needs.

One advantage of the soil type is that water drains through quickly and recharges the underground aquifer. Soil can be treated (with fertilizer, compost etc.) to grow plants in, but the make-up of the soil can't be changed to enhance its drainage capabilities. What this means for agriculture in the area is that farmers need to look after their soil regularly, making sure it gets enough water, food and maintenance.
Soil is not the problem when it comes to growing food, as is evident in the thousands of urban and community farms currently operating in the Cape Flats area. According to Rob Small (Co-founder of Abalimi) the correct attitude and will, along with the needed support, enables a farmer to grow on any land no matter how bad the soil is. Oranjezicht City Farm in Cape Town, one of the best-known and successful urban farms in the Western Cape, started their farm on a bowls lawn, some of the worst soil imaginable for agriculture (abundance of pesticides used over many years to kill every little organism in the soil). With the right attitude, attention and natural products, you can make any land fertile once more.

Image 43: Spinach growing in the sandy soil of Gugulethu, a neighborhood close to Delft.

Image 44: An urban farm in Nyanga in its Late development stage.

Image 45: Oranjezicht City Farm in Oranjezicht, Cape Town, four and a half years after rebuilding the lifeless and unfertile soil of the bowling green.

Image 46: An urban farm using leftover space at the Fezeka Municipality in Gugulethu in its early development stage.

After investigating the natural resources, I took a closer look at Delft in its urban environment in relation to food production and retail. In its isolation, Delft's residents took advantage of the lack of services, transforming the envisioned residential neighborhood into a bustling informal retail and entrepreneurial environment where all kinds of trade takes place along its main spine.

There is one formal entity, Spar that serves the entire neighborhood and a Checkers is under construction and will open in 2017. Residents prefer to buy fresh produce from local spaza shops or local street traders for various reasons that include affordability (smaller quantities), easier access and lengthier operating hours. (Battersby, Haysom et al., 2015a) However, these operations are not without problems. Lack of storage to keep produce fresh, the distances owners have to travel to buy produce (bakkie hire and petrol expenses) and the lack of safety during night times (theft of produce) result in great amounts of energy spent to reach small profit margins.

During our site visits of Delft we uncovered some interesting information regarding the informal retail sector. We already know that the formal entities have their goods delivered from a centralized warehouse in the metropolitan region, but what we found truly significant was the lengths that some informal traders had to travel regularly to collect goods. There was one guy selling eggs that traveled to Malmesbury on a weekly basis while another couple selling grapes from the back of their bakkie, travelled to Wellington every second day to pick up produce. Many spaza shops acquired their produce either from Epping market in Bellville or from Philippi. Stepping back for a moment and looking at the footprint that is feeding Delft, it is a considerable region from where produce needs to be transported almost daily. My project is arguing that we need to decrease this footprint significantly and start producing locally. This will not only benefit consumers (lower prices) but also retailers, saving them huge amounts of travelling and time that equates into higher profit margins. Decreasing the footprint could be quite a challenge, but by looking a little closer at Delft, we discovered some encouraging facts.

Image 47: Goods sourcing maps showing the footprint currently feeding the majority of the Delft

Agricultural Interest

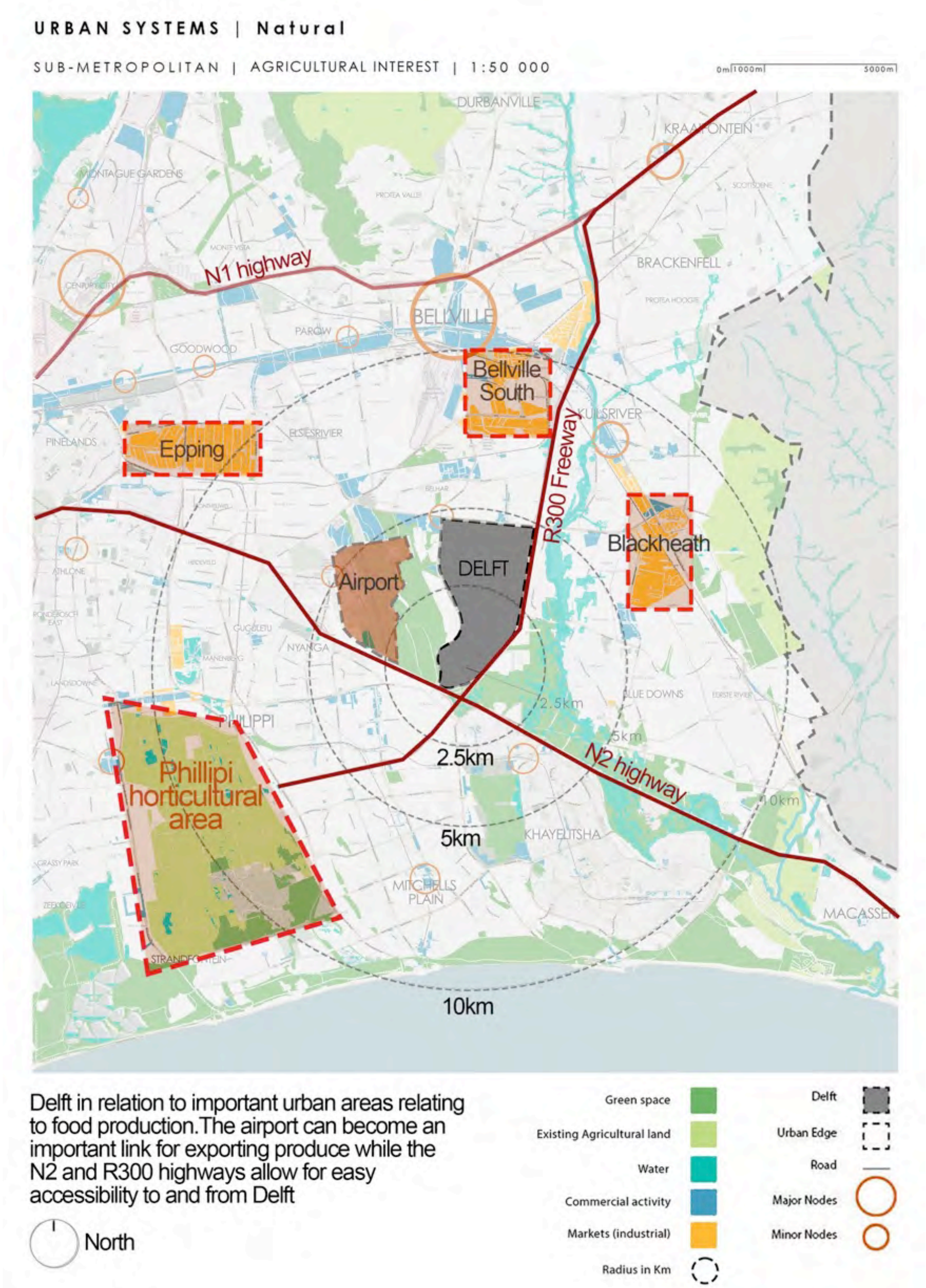


Image 48: Locating Delft in relation to important urban areas and links in the food system

Through our mappings of Delft we came to realize that there is considerable potential in its location. Cape Town International airport is adjacent while the railway line and R300 and N2 highways hold Delft as a neighborhood. Delft is also located close to the most prominent markets in the Cape Metropolitan namely, Epping-, Bellville- and Blackheath market, big links in the food retail industry of the Cape Metropolis. The highly productive Philippi Horticultural Area, the bread basket of Cape Town, is within 10km, offering many opportunities and connections within food production.

Currently community farms and home gardens from leading NGOs are all being erected all over the Cape Flats area and Delft, located centrally and with an abundance of open land, certainly appeals to these organizations for future projects. Not only this, but its ideal location is seen as a massive advantage for future investment, not only for food production and food exporting, as can be seen by the new mall being constructed on main road at the moment.

High unemployment rates mean there is labor available, and with the available open land, one only needs to showcase the success that a farmer can reach financially, nutritionally, physically, spiritually and socially to really generate interest in becoming part of such a project. The benefits speak for themself, and by establishing farming as a lucrative urban profession for the youth and young adults, the opportunity for success becomes even higher.

There is already a strong economical argument for local food production and after investigating Delft in more depth, it became clear that it could become an important site to facilitate and support this argument. In its location, it has the natural resources available as well as the infrastructural opportunity to become an important link in the food system, both in the formal as well as the informal sector.

The aim of this project, and this investigation, is to establish a model of production and operation that is sustainable and successful in most conditions around the country. Enabling people to produce food locally and creating an economic opportunity can prove the viability of a flourishing informal trading sector that supplies poor people with affordable and accessible healthy foods. It can also become part of the solution to solve food insecurity in the majority of poor urban settlements around the world. This, in conjunction with a sustainable and accessible operation for food production, can become the catalyst for a healthier economy, a healthier environment and healthier cities where equality is at the forefront of development.

- Siting -

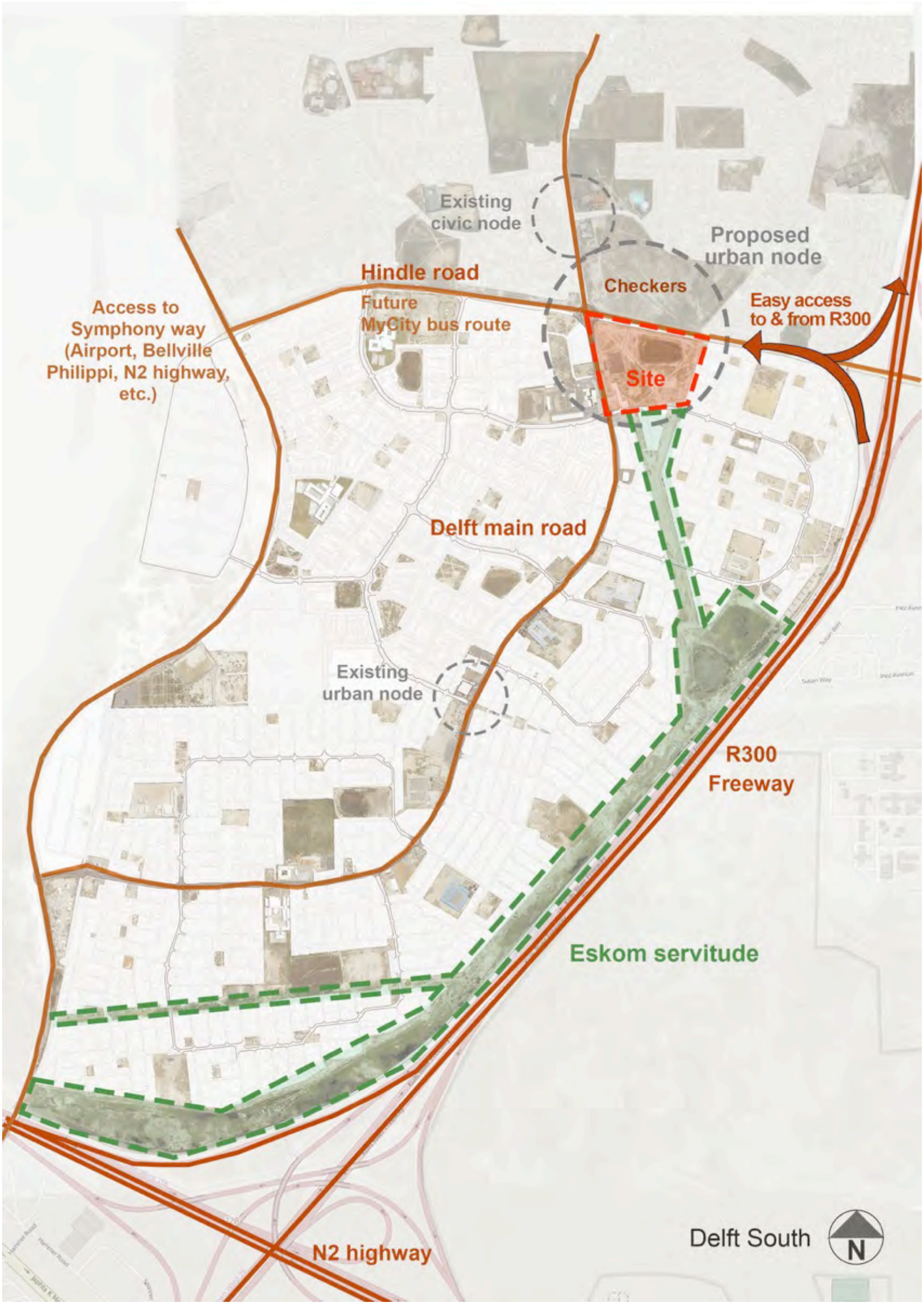


Image 49: Identifying the Eskom servitude and the site for my project

Through the research and mappings my site became very clear to me, even though it was at an urban level at first. While mapping out all the open spaces available for agriculture in Delft South (our area of focus), one specific strip became very apparent. This was an Eskom servitude that had huge agricultural potential. This road and service reserve stretched from Hindle road all the way around the Eastern and Southern border of Delft South. This large open piece of land would become the agricultural strip where all my farming would take place, an uninterrupted stretch of land that could be converted into a place of beauty and production.

This servitude has been vacant since the inception of Delft as a suburb in 1987 because of it's zoning as a road and service reserve. Several small-scale farming projects have been attempted but all of them failed for various reasons that included government politics, lack of funding and theft. This land is currently vacant and not only dangerous open space where crime and drugs are rife, but also unused except for pigs and cattle wandering around. This strip holds Delft as a neighborhood and also attaches to many other open pieces of land such as retention ponds and open public sites making it the ideal strip for my agricultural production land.

Another advantage is the natural gradient of the site, sloping from North to South, allowing water to flow naturally from the top to the bottom of the strip. (MLH, 1987)

Proposed urban node

Image 50: Locating my site in relation to the urban node, Checkers and the Eskom servitude

Once this large piece of land was identified as my agricultural strip, there was no doubt as to where my site would be located. Right at the top of this strip was a large piece of vacant land sitting ideally between Hindle Road and Delft Main Road. This not only provided near perfect access to and from the R300 and N2 highway but also allowed me to develop a project that could benefit and contribute to the life of Delft Main Road.

Situated across the Checkers mall that is under construction to the North and other civic buildings such as the engineering depot, Delft waterworks and a bread factory, this node was begging for a productive and bustling corner. When entering from the R300, my site would be the first large open space you encounter and being situated right by a traffic circle, the first place where vehicles would slow down and taxis would pull over making it the ideal site to erect some form of a landmark, a symbol and a gathering place for the people of Delft.

The large piece of vacant land across Hindle Road was initially seen as more place to farm, but since Checkers Mall is being erected it adds to the productive and bustling life of this corner. Not only that, but Checkers could potentially become a valuable asset to my project – supplying it with fresh produce and fish while relieving them form large amounts of food waste that I can recycle and reuse as compost.

Currently there is an existing detention pond, an electrical sub-station, a small shop and a temporary church tent on the site. The retail house and church tent is right in the southern corner while the sub-station and retention pond became significant parameters for my design.

The vision and reason why I chose this site was for it to become the head of the agricultural strip where produce would be processed, packaged and distributed from, establishing it as the heart of the operation.

- Urban Strategy -

Image 51: Urban strategy

In order to deal with a site of this magnitude, 15-20Ha in total, it needed to come down to a human scale. I developed a grid based on the 500sqm plot size, referencing the R6000p/m livelihood stage urban farm developed by Abalimi to break up the land in more manageable portions. (Small, 2016) Three plot sizes were required to cover all the land: 50x10m, 30x15m and 22x22m being the most common one. The detention ponds are retained and mostly function as wetlands while some pockets of space allowed for potential community gardens. Infrastructure was the next step as all these plots had to be accessible to and from the central hub, to receive and distribute goods and services.

A tractor route would be constructed to allow for easy access and pick-up of produce on a weekly basis. This road would also serve as a pedestrian connection route, a social space as well as an exercise route for local people to enjoy and use on a daily basis.

At this stage I had to find a way to get water to every plot on my agricultural strip. I investigated the traditional "*leiwater"* water system that was common in many towns around South Africa. Grahamstown, Stellenbosch, Montagu, Greyton and Stanford are a few examples of where the *"leiwater"* system was used. It uses gravity to feed water from a stable source along a concrete canal, usually situated next to the road. Each plot adjacent to the canal gets a certain time window every day, usually about 10minutes, where a plate is opened directing the water into the plot and into the garden for irrigation.

In my scheme, this system would run from my central hub all the way down alongside the proposed road, supplying all the separate plots with water. The success of the system was in its rigor, its history and its social attributes. There was however a big drawback in using the *"leiwater"* system in a project where water management and optimal water use if of utmost importance. Because of the high summer temperatures, evaporation would cause too much water to be lost. Another drawback was its vulnerability to pollution. After some productive meetings with engineers at Elsenburg, we came to a solution: an underground irrigation pipe would be installed to distribute water from the central hub to all the plots through a series of pumps.

A borehole would fill a holding dam while different pressure pumps would supply water to the plots according to the irrigation pressures. As water is pumped the borehole would always keep the holding damn at a constant level to make sure the required pressure in the pipe is always kept.

For the distribution of tools and services, I investigated the idea of implementing a series of sheds located within a 200m radius of all the plots, close to main access routes, that would contain tools and equipment. There would also be a windmill and a dam for extra water requirements. This might cause security concerns, as theft of equipment is a very common occurrence in agricultural projects around the Cape Flats and South Africa. This idea will still be considered as the project gets developed, perhaps by using containers and appointing caretakers.

The social quality that the *"leiwater"* system can bring is something I want to retain and will thus develop the irrigation system to include some open, flowing water for kids and residents to enjoy.

Each plot will receive its water from an off-take pipe and a small plastic tap. These taps will ideally be hidden from view by using design elements that will feature along the walkway. The use of plastic is key, as it is often perceived to be of lesser value and not worth stealing.

Plots will be made available to residents living on the periphery first to allow for some visual security. Ideally you want the community to take ownership of their land and their produce, but as crime is a constant problem in the area, other methods might have to be considered to keep crops safe. All tools and equipment will be kept on site in the initial stages of the project.

Other possible connections are to the spaza shops where plot owners can arrange to sell to local spaza shops, be it leftover produce for the day or the week. This would allow residents to access more healthy foods from their local spaza shops, after-hours and within close proximity at affordable rates.

The vision is for this piece of barren land to become a productive agricultural strip, a place where nature is reintegrated into the urban and social fabric of Delft and for it to become a place that gets looked after by the community as they realize the value and the opportunity that it brings.

Image 52: Urban strategy – water

Image 53: Urban strategy – tractor route

Image 54: Urban strategy – Sheds

Image 55: Urban strategy – Produce route

Image 56: Urban strategy – energy

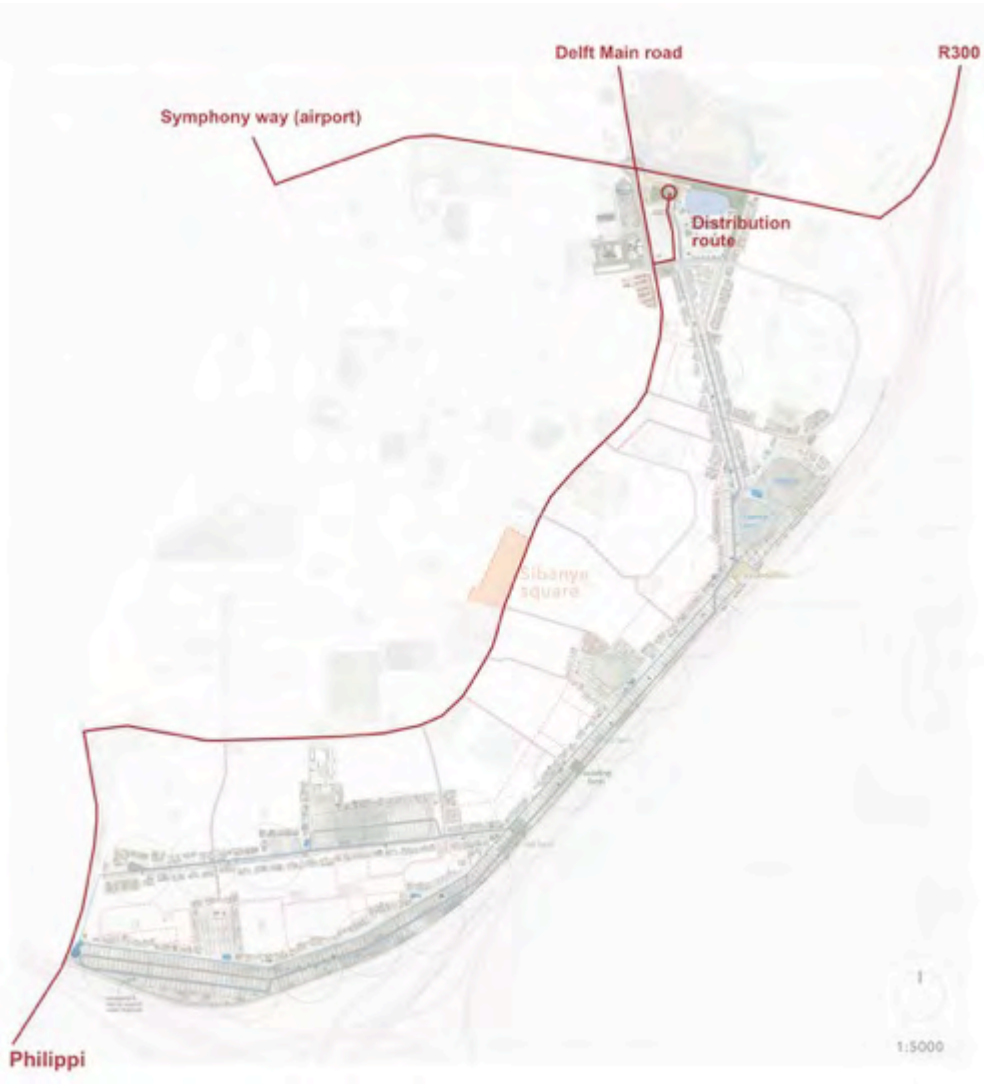


Image 57: Urban strategy – distribution routes

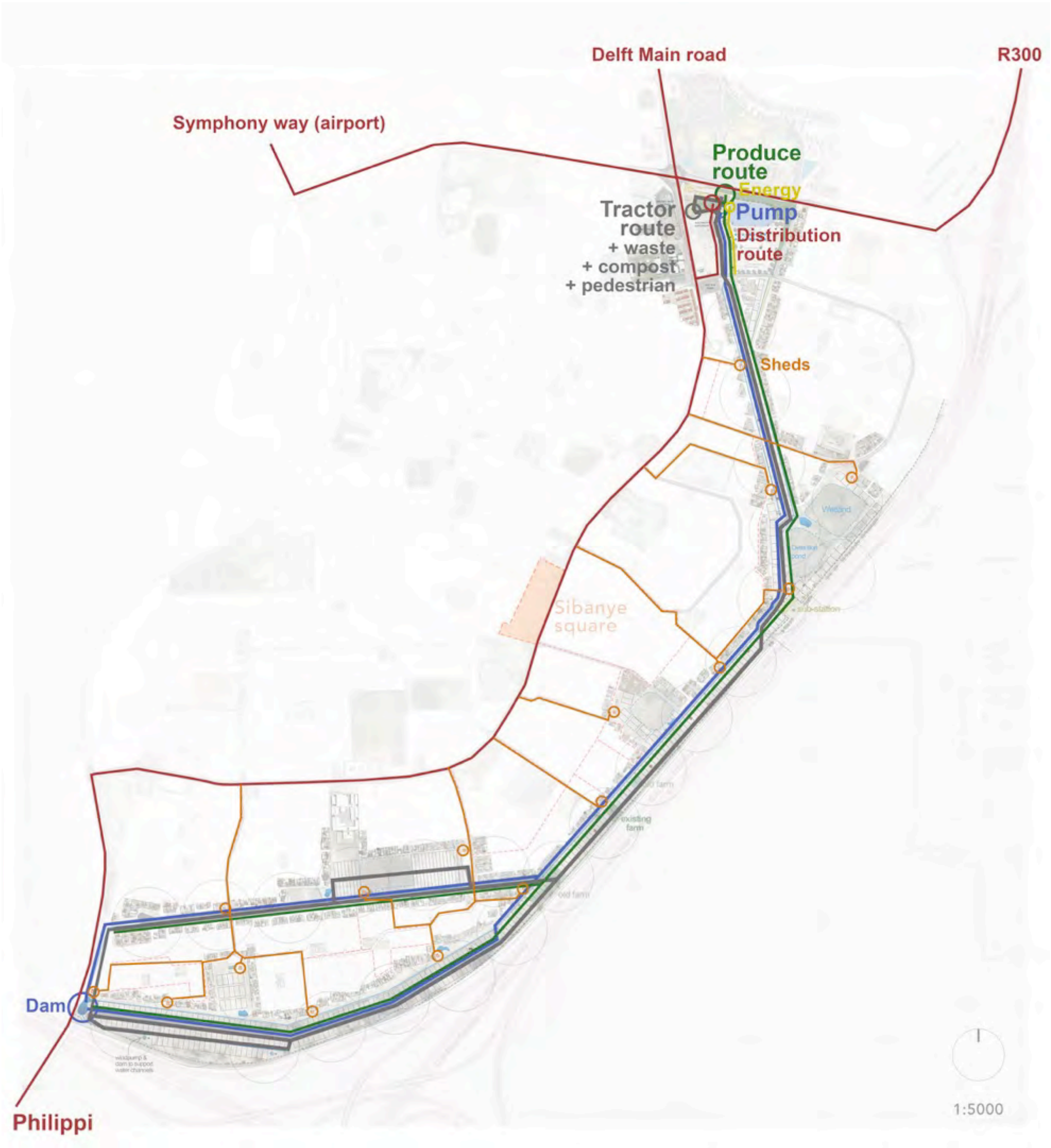


Image 58: Urban strategy – overlay of all urban systems

- Site strategy & programme -

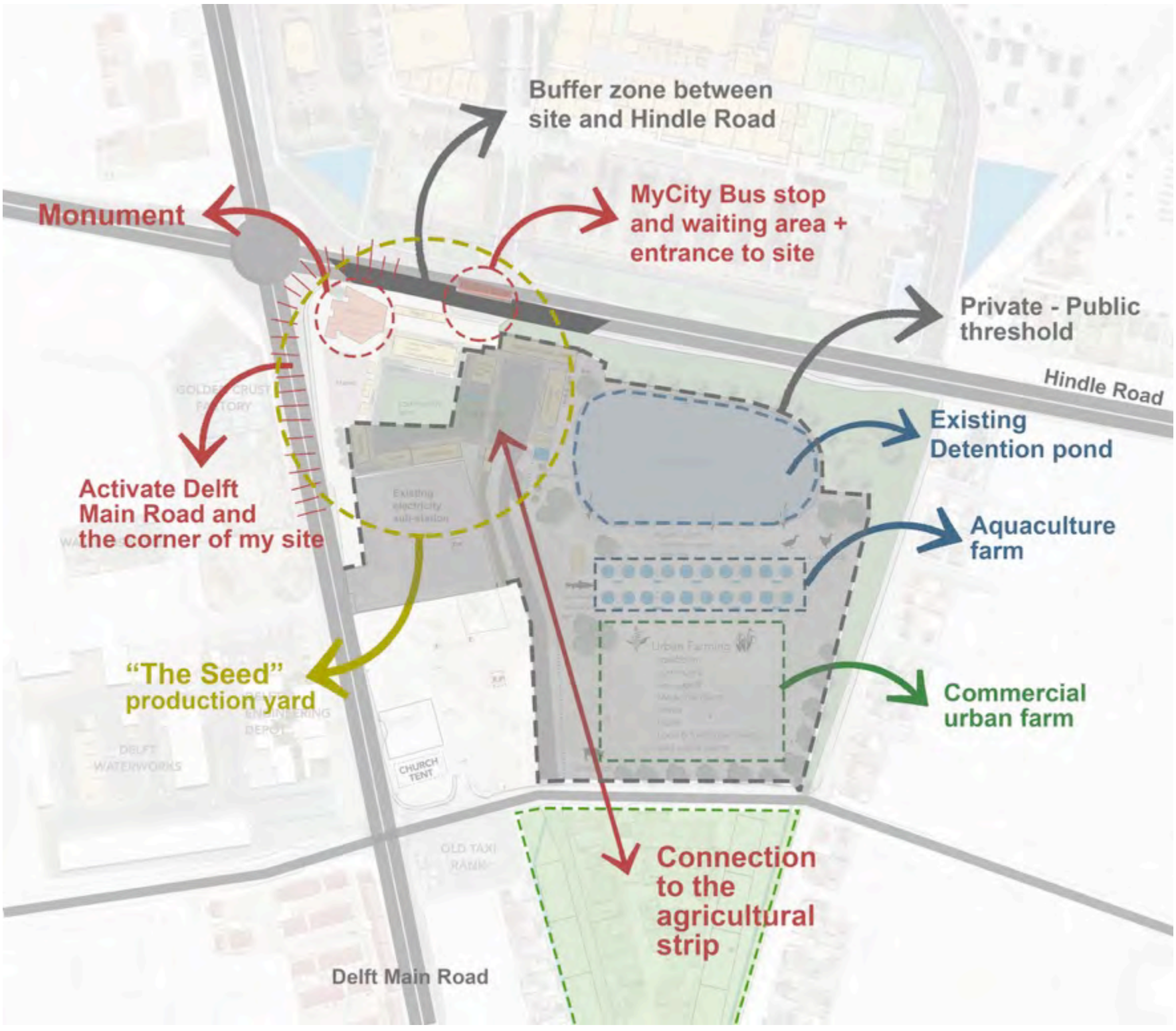


Image 59: Site strategy

The site is currently a large piece of barren land that, as I have identified through my mappings, can have huge potential in my urban framework and form part of an important urban node in Delft.

Some of the key strategies were to activate Delft main road, to create a buffer zone between my production "yard" and the busy Hindle road, to create a landmark on the corner that would become the focal point of the whole project, to engage with the proposed MyCity bus stop and to establish a connection to my agricultural strip.

The site would also contain a commercial urban farm where locally trained personnel would grow selected in-demand produce to generate extra income for the project as well as re-establish and grow certain traditional, edible and medicinal plants, flowers and herbs. This farm would be focused on supplying commercial and culinary markets with scarce and valuable produce. Plants such as watercress, *"spekboom", "waterblommetjies"* and selected herbs and micro-greens will be grown for restaurants, export and for corporate investment.

The detention pond on site would be converted into a retention pond so it can function as a wetland in the summer and a dam in the winter. Water-loving plants will be planted along the edges forming a natural habitat for insects, birds, amphibians and poultry.

There will be a commercial aquaculture farm on site that would consist of 20 x 50 000 Liter tanks that could produce up to one ton of fish per week. (Flemming, 2016). The nutrient rich water from the aquaculture farm would be used for irrigation on site when it isn't being recycled back into the system (water needs to be discharged occasionally depending on the system). The rest of the site will be used for agriculture, livestock, and composting.

There will also be housing for the caretakers on site and I want to develop a residential component that can function as guesthouse and could be used for weeklong workshops and other training events on site.

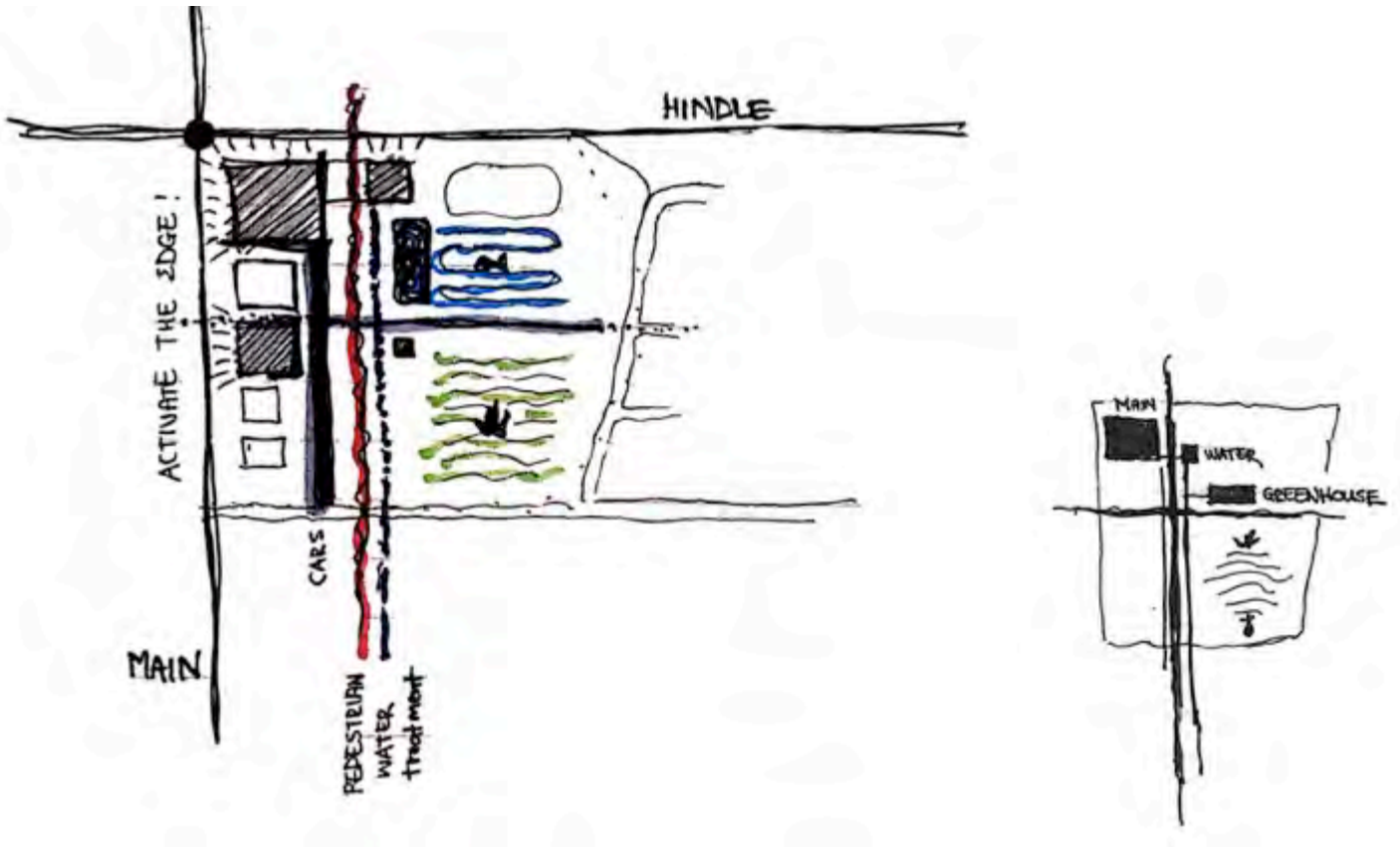


Image 60 & 61: Conceptual sketch (left) and diagram (right) for site development

Image 62 & 63: A large net being used to create a more suitable environment at Boschendal's food garden for selected plants and seedlings to grow in. Irrigation pipes run along the top of the modest structure to water plants and to keep air cool and moist.

Image 64: First draft of site strategy identifying the importance of the North-Western corner for the development of my programme.

The north-western corner of my site was identified as the most important area for my project and it is here where I wanted to establish the heart of the operation, the seed. Corners in Delft are usually well utilized and I wanted to create a place that could contribute in a significant way. The northern-most tip would be a place to create a landmark that shouts: “here we grow food” and that is why this corner is such a vital part of my project. It would become the billboard for farming, showcasing the lucrative opportunities and the beauty that it can bring to a neighborhood along with other investment opportunities, not to mention the vast range of healthy foods and the healthy lifestyle it embraces.

Image 65: Conceptual sketch in developing a contrasting and significant landmark.

When this previously barren land is operating at full capacity, I envision a highly productive space filled with driven individuals and bustling with life. People buying fresh and delicious dishes hand made on site, enjoying the beautiful community farm while they are waiting for friends or family or getting inspired to learn more and becoming part of this new desired urban lifestyle filled with opportunity. This node must become the life of the community and a place to treasure and admire in the community as it contributes so much to the people of Delft.

It will however be important to keep the whole operation secure, especially the production side that will be full of valuable equipment and goods. An ex-policeman from Delft will do a security assessment of my site and advise me how to keep the site secure and safe after hours. A combination of a series of fences and gates and the highly effective Kei-apple hedge will be used to keep the site secure. This Kei-apple hedge is a thorny plant that, when well maintained, can form a formidable hedge and it will also allow the fences to become nature.

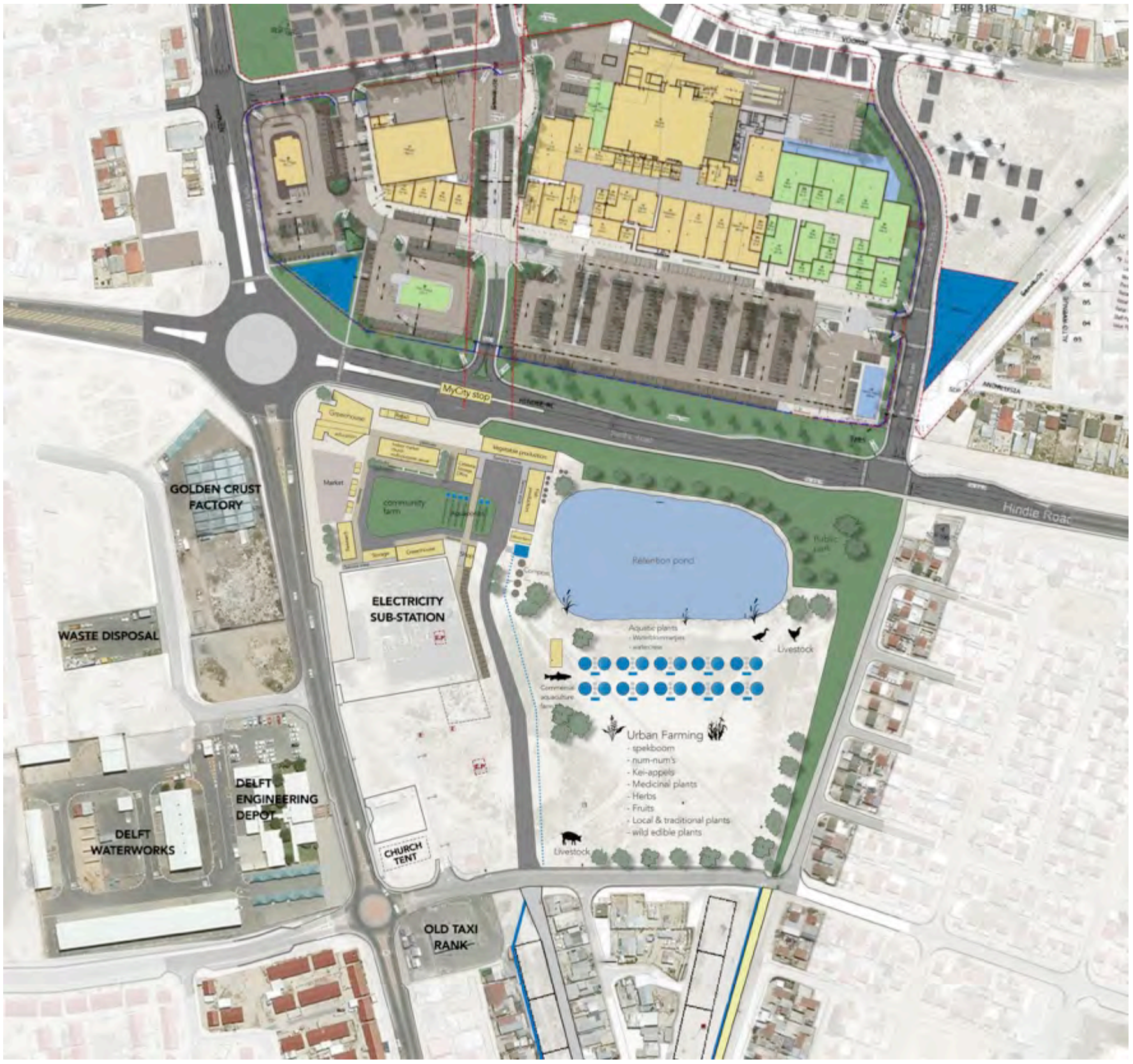


Image 66: Final site strategy in context of the urban node, Shoprite Checkers and other important infrastructure.

- The Seed -

Initially, I was intent to include most of the programme in this landmark building but soon realized that the project would become much stronger as a series of buildings. I started by developing a series of open spaces and courtyards that could support and arrange the buildings on site. At this point, there was a whole list of open spaces that were shaped by built infrastructure.

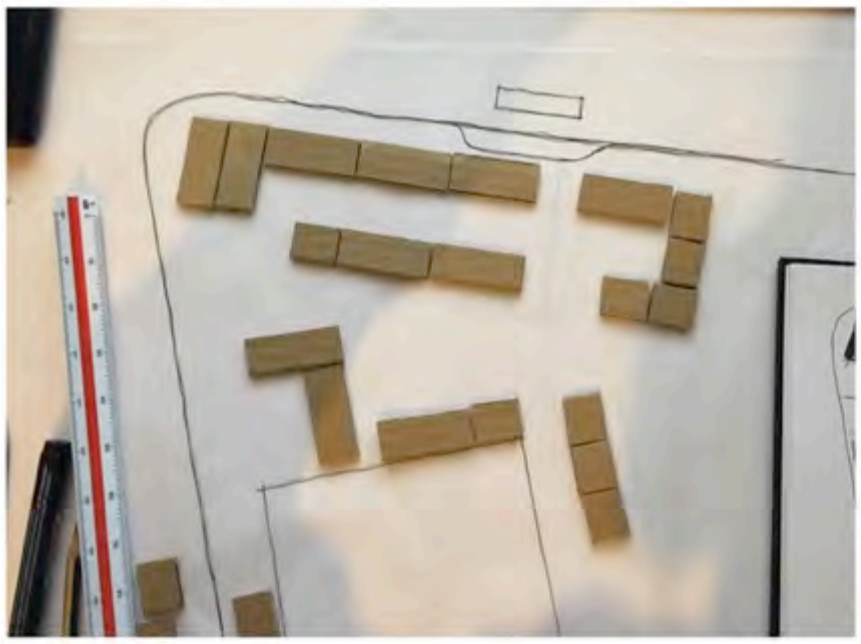
Looking back at my research I knew that my site required a centralized hub containing a production component, a research, support and educational component, a market and retail component and a gathering component. This would form the base for developing the programme and the architecture.

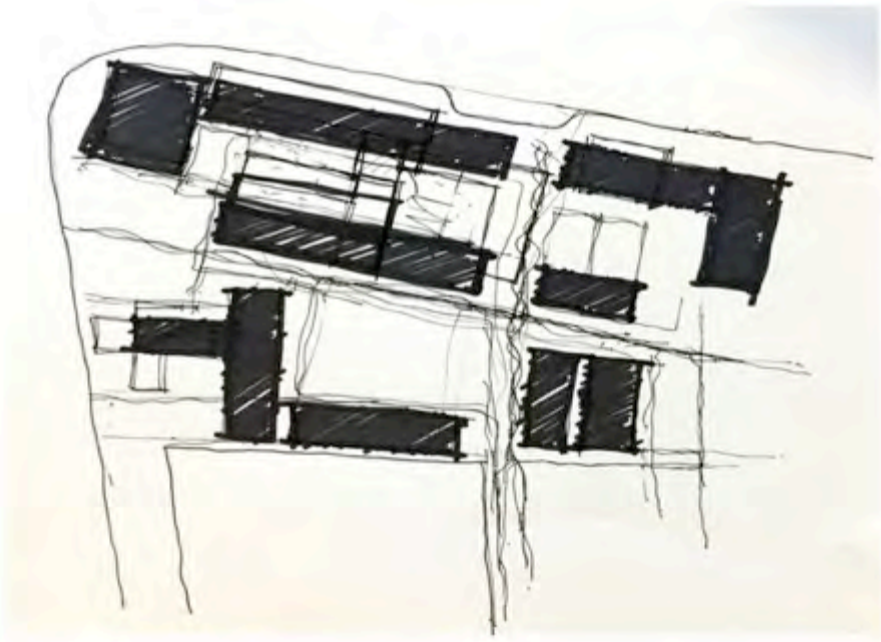
Looking closer at the key programmatic components, I developed supporting programme that included storage, offices, a greenhouse and administration. The challenge was to develop and combine these key components and supporting programme and figuring out where it should fit on my site. Roughly assembling them into eight groups and using 8m x 10, 20 and 30m length blocks on a conceptual model, I arranged these blocks in many different configurations. After many shifts, I used recognized and developed the idea of the traditional *“plaas-werf”,* found in most farms around the world, to organize the programme and develop the site further.

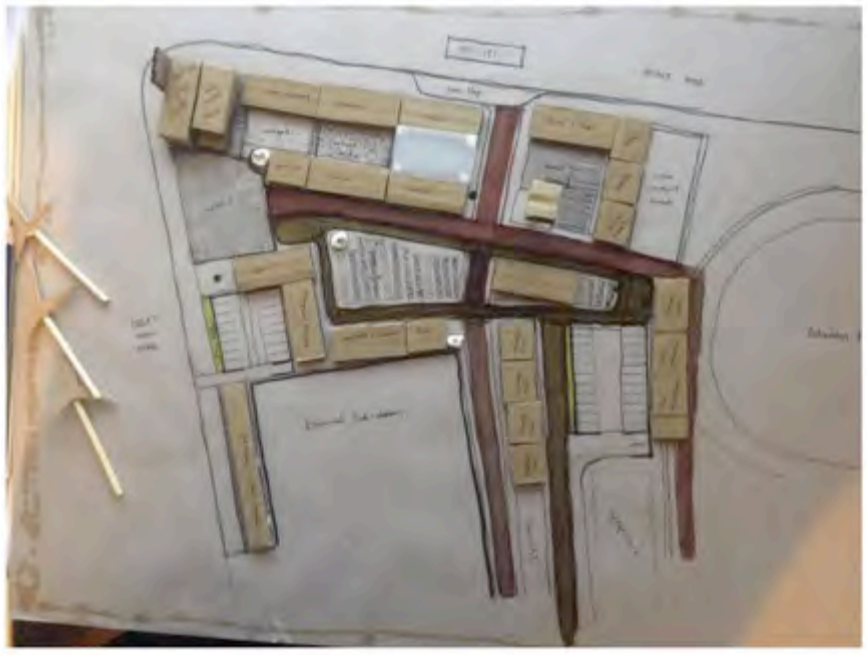
The idea was to categorize the programme into private and public zones and to then arrange them on site accordingly to hold and support the identified open spaces. These open spaces were now key components of my design development and consisted of a market, a community farm, a public “yard” and a private “working yard”.

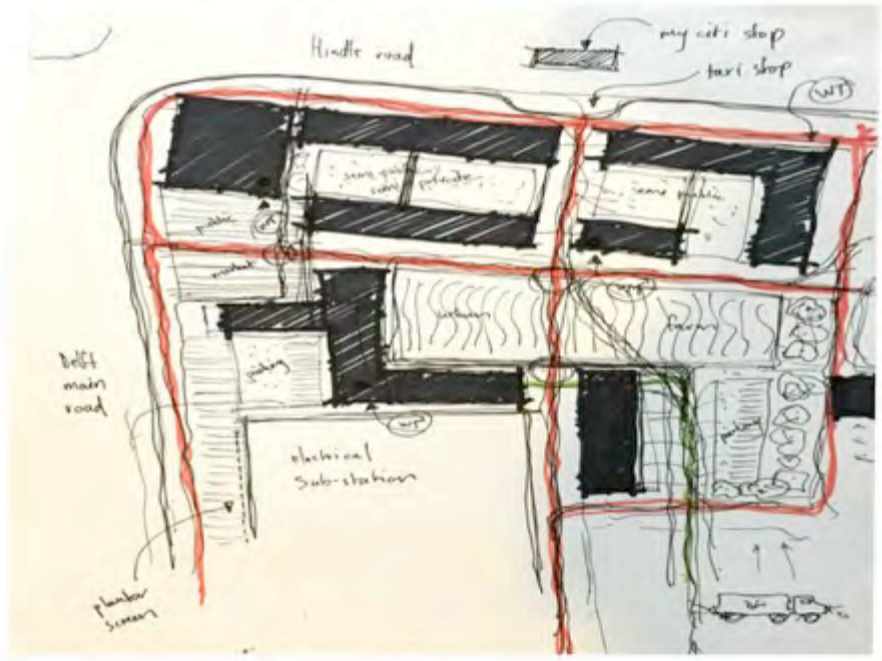
The working “yard” consisted of a vegetable production operation, a fish production operation, a cafeteria, offices and storage space for produce. The public yard consisted of an indoor market, a church, retail units, a MyCity bus stop and waiting area and a monumental public, mixed-use greenhouse and educational building that would serve as the landmark. This formed the basis of the site organization. The working “yard” would become the private production side of the site and would include storage space for farm equipment, a worm farm, an aquaponics setup, a composting area, a commercial greenhouse, a research facility, a laboratory, and a shop that supplies the farmers of the agricultural strip with compost, tools and seedlings. The public side of the site would include the outdoor market and community and educational farm.

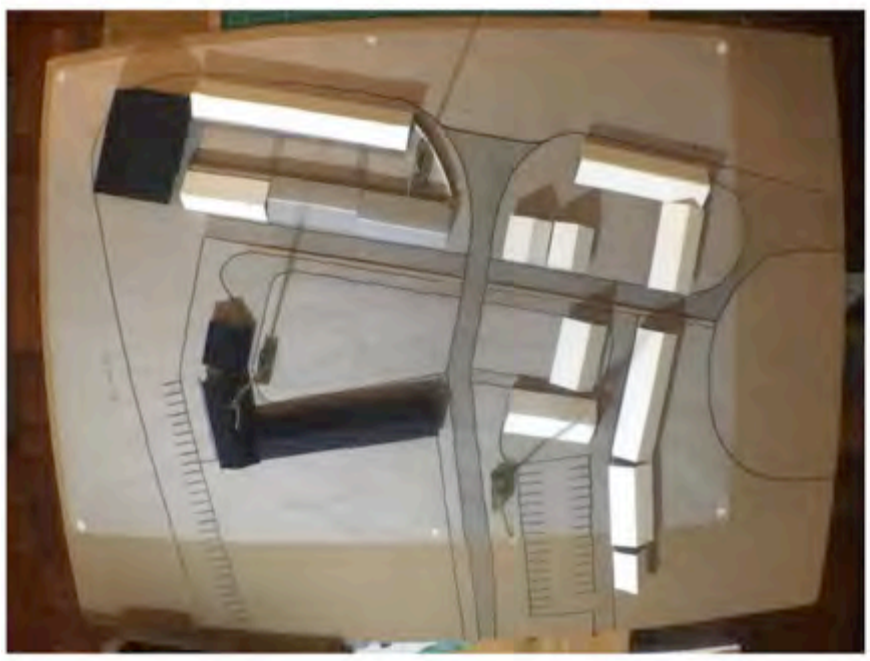
Once these “yards” where established, it allowed me to start investigating the pragmatics of the programme and optimizing the operation both architecturally and systematically.

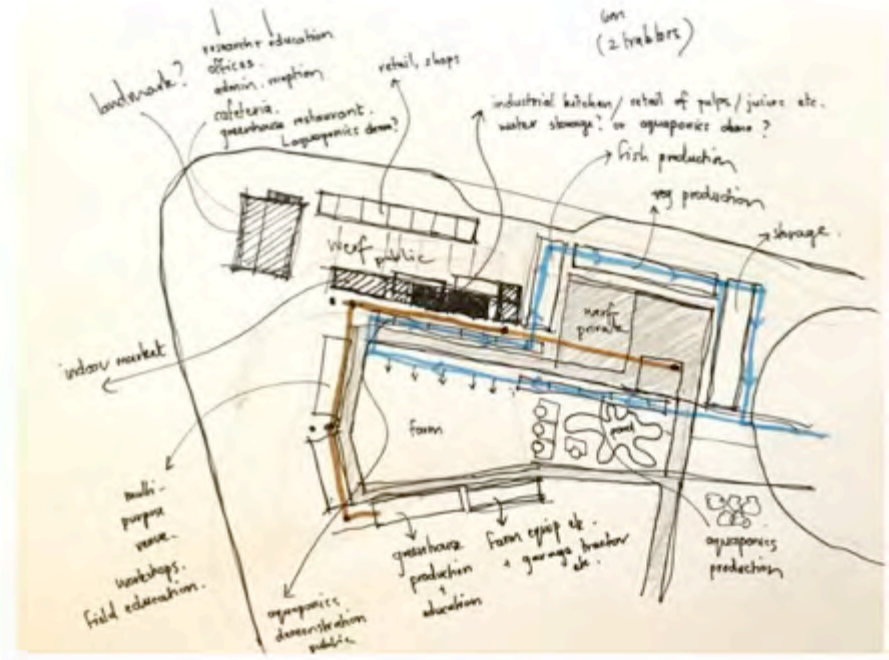


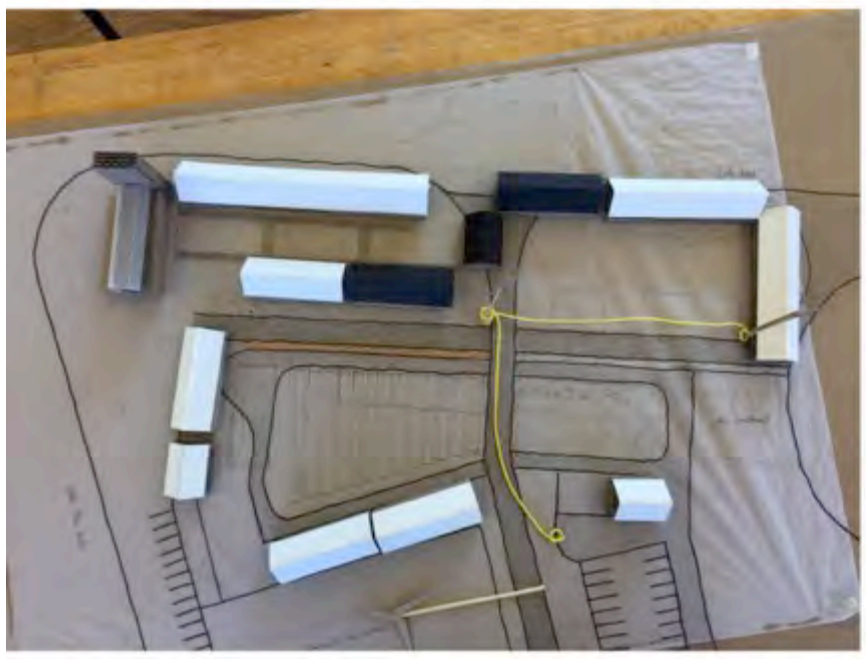












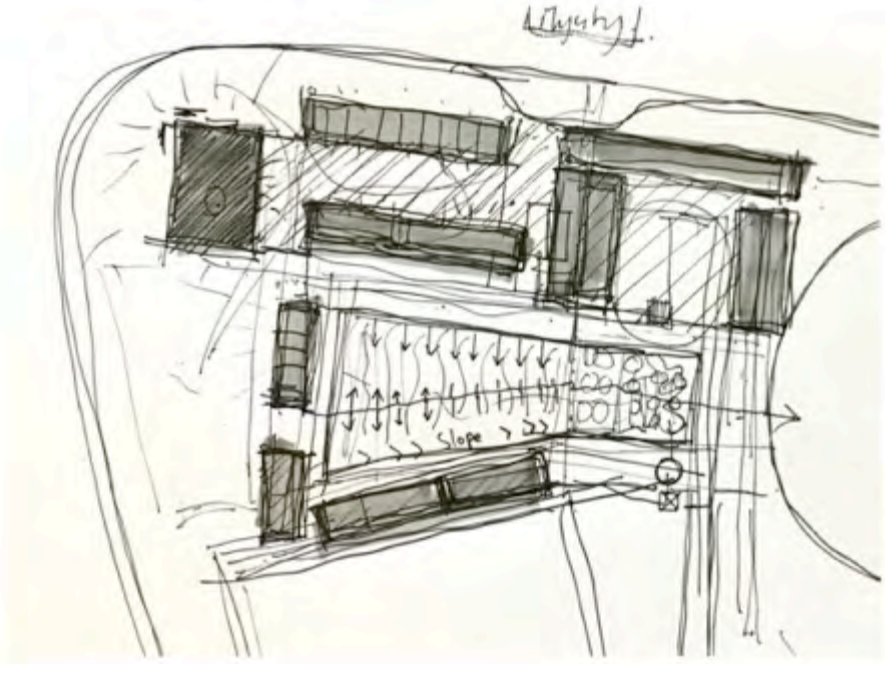


Image 67 Aligned left: Developing the site through models.

Image 68 Aligned Right: Developing the site through sketches

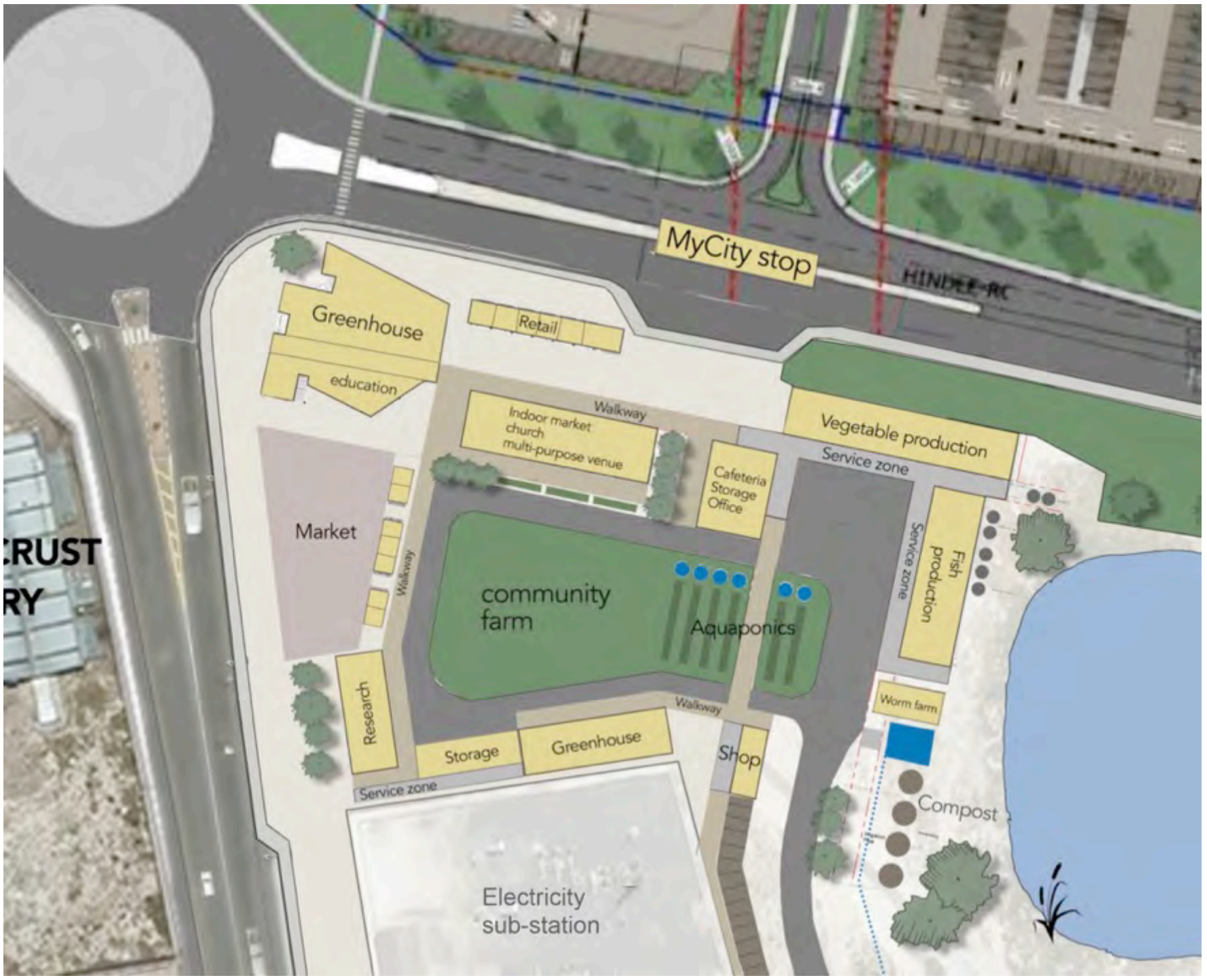


Image 69: Final layout of the seed

Systems

The Seed will be the head of the operation – the place where the project starts and where it ends. The basic infrastructure was now in place. From here I developed a series of systems in conjunction with a service zone. The systems, including all the urban systems and the service zone would be integrated and would co-exist and function together with the programmatic requirements, the infrastructure and the open spaces. These systems helped to develop and optimize the final site layout and included rainwater harvesting, greywater recycling, blackwater recycling, solar and wind energy harvesting, produce production flow, fish production flow, private and public circulation flow, a tractor route and food waste recycling.

Where services aren’t required, mostly in the public “yard”, the service zone would become a covered walkway with a service gutter and vertical planters. This service zone allowed me to develop the programme in conjunction with the services and the systems to arrive at an optimal configuration for maximum output and seamless operation on site.

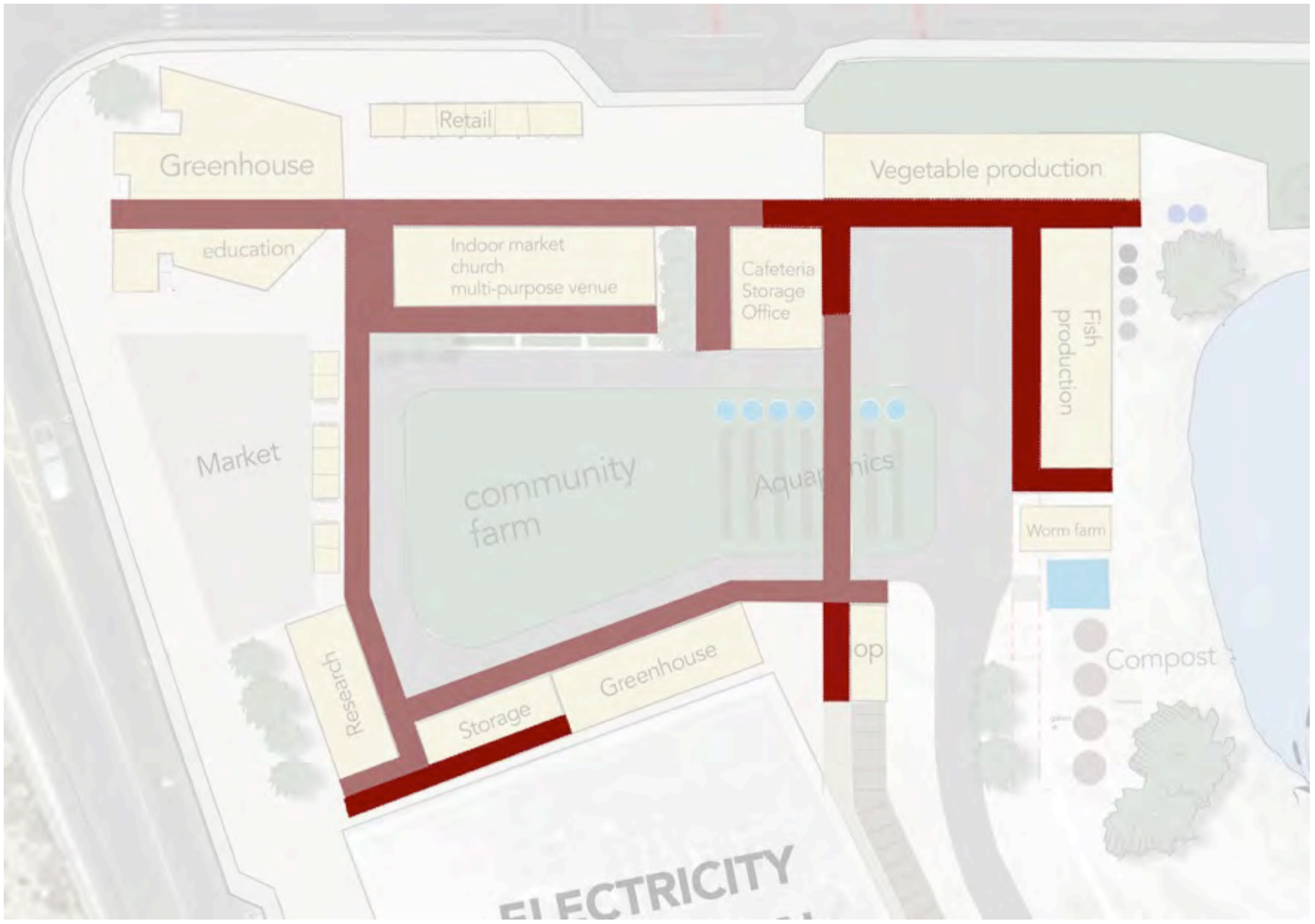


Image 70: The service zone. Note: Dark red indicates hard infrastructure while light red is mostly covered circulation with a roof gutter.

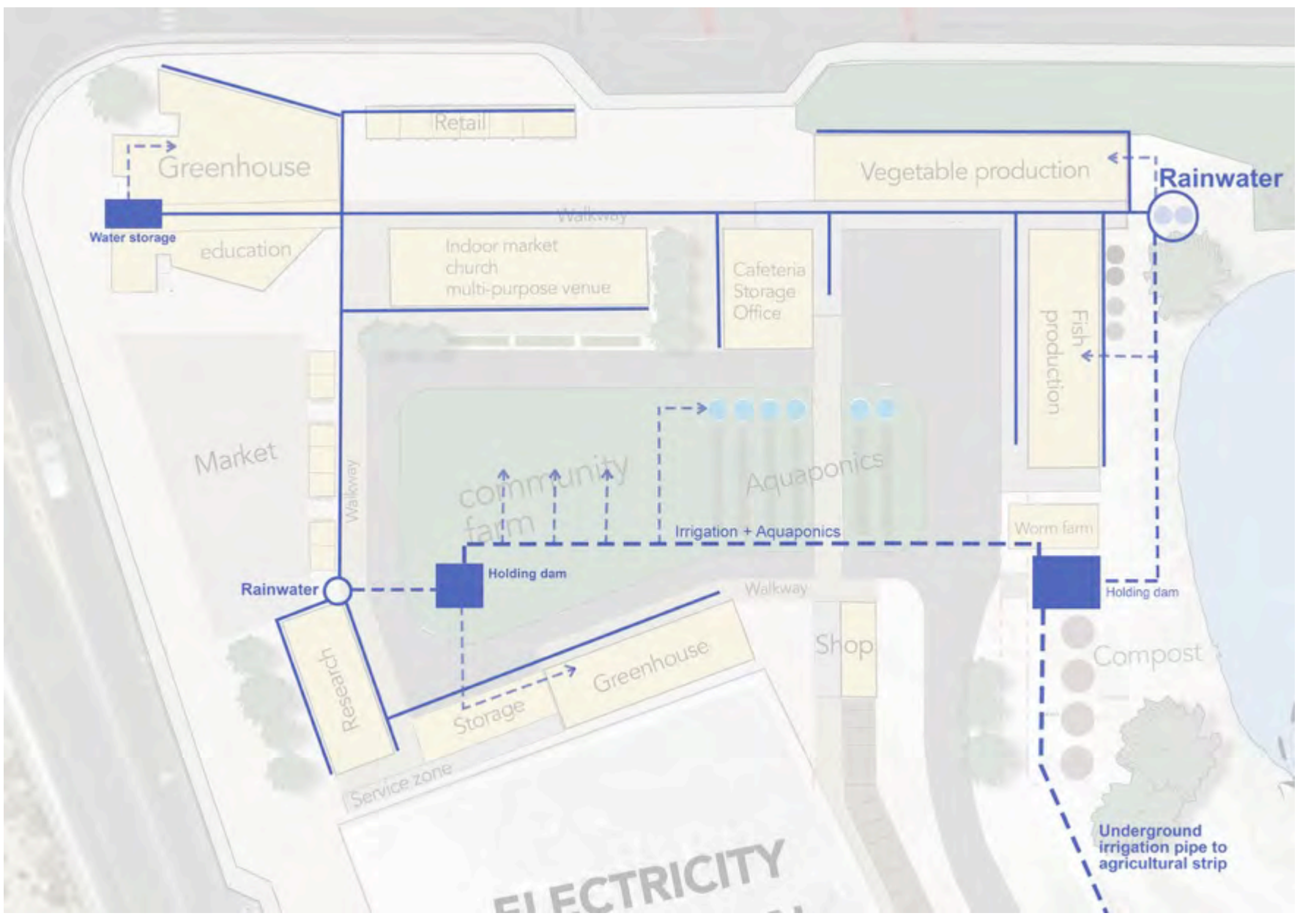


Image 71: Rainwater harvesting. Water to be stored in holding tanks and dams on site and will be used for irrigation, aquaculture and aquaponics setups and if possible, potable water.

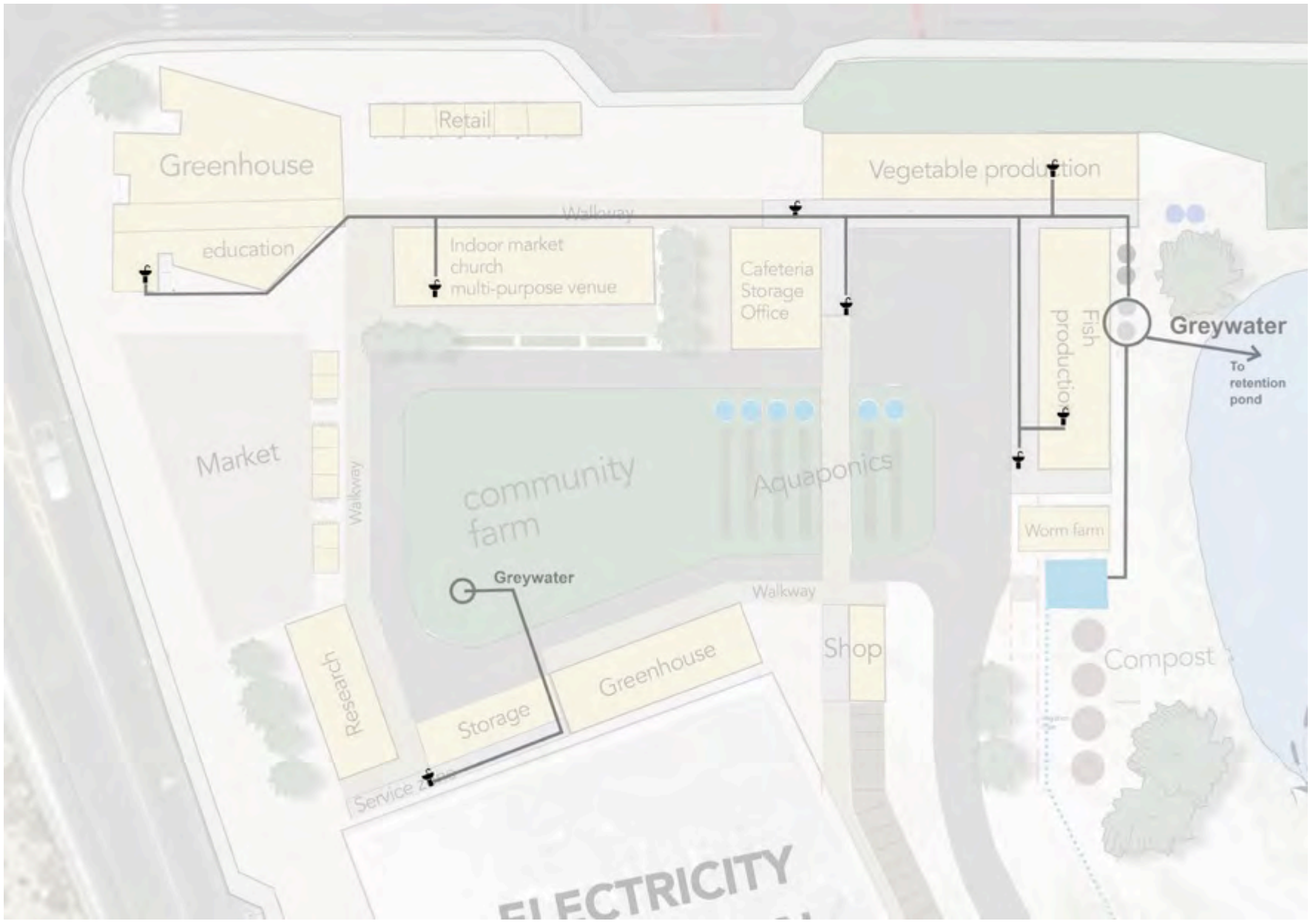


Image 72: Greywater recycling. Note: Water will be used for irrigation when rainwater is scarce and excess greywater will be pumped into the retention pond.

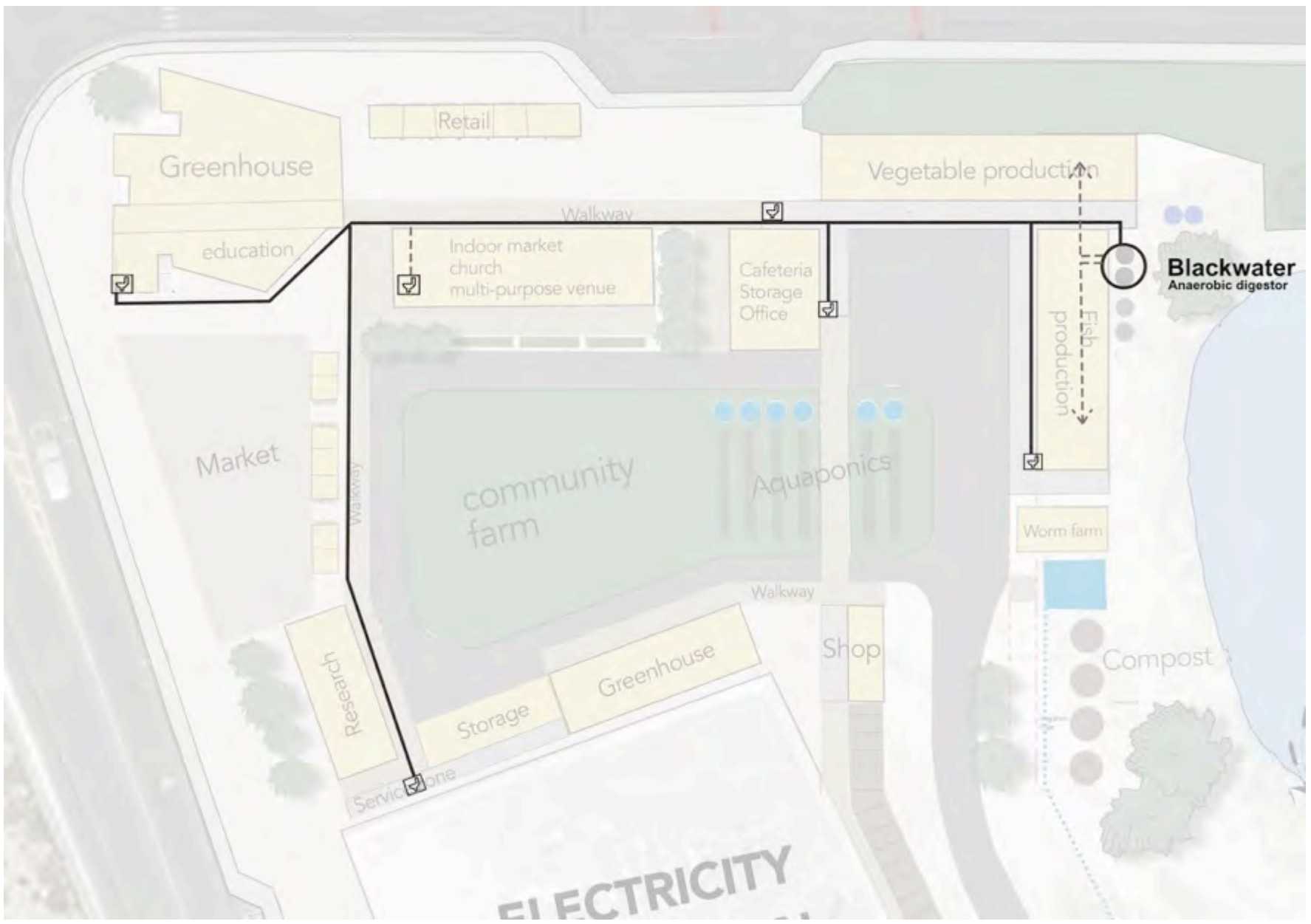


Image 73: Blackwater recycling. Note: To be converted into gas and fertilizer. Gas is used for cooking in the produce and fish production operations and fertilizer is used on the farm.

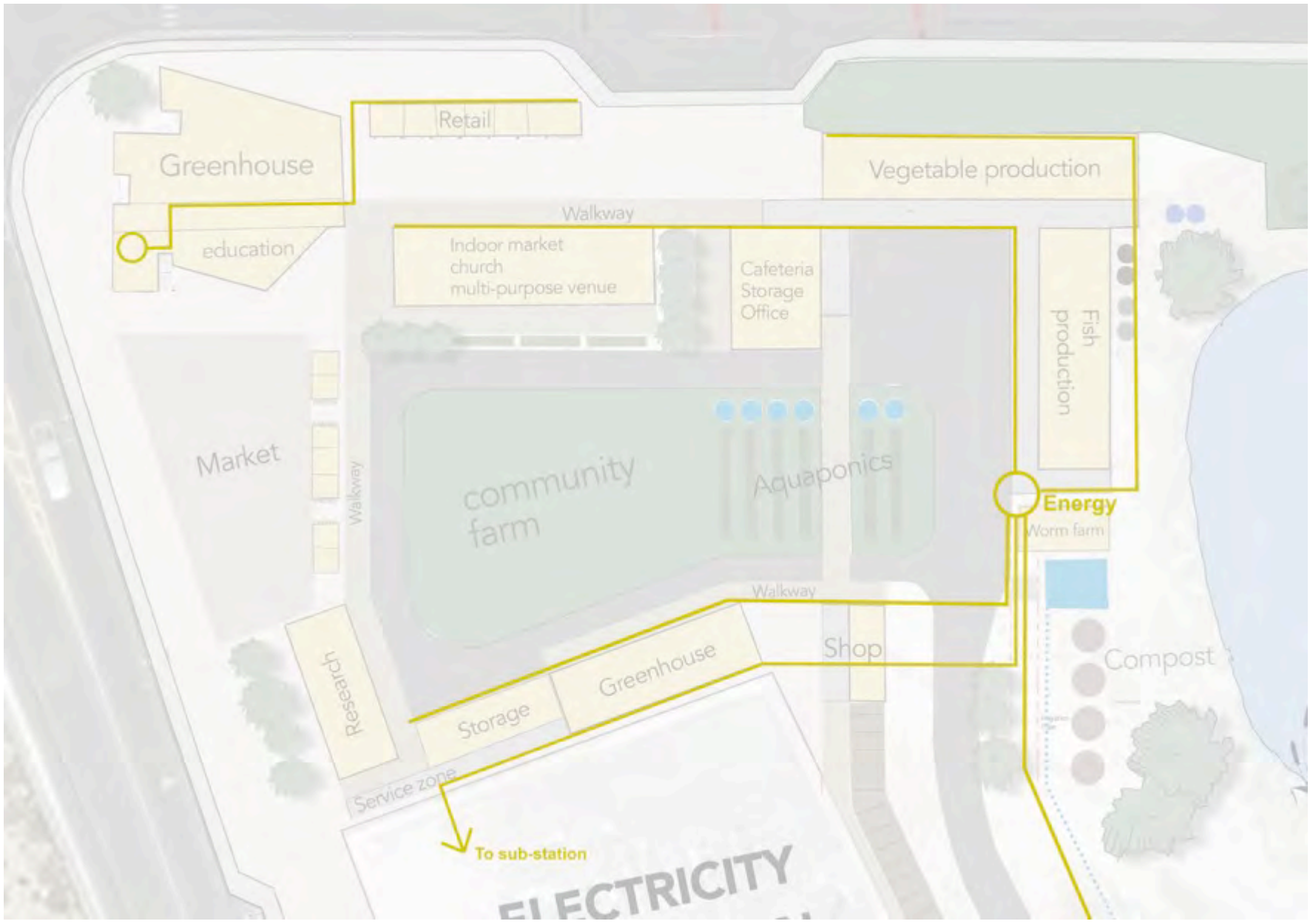


Image 74: Sun and wind energy harvesting. Note: Excess energy fed into the grid.

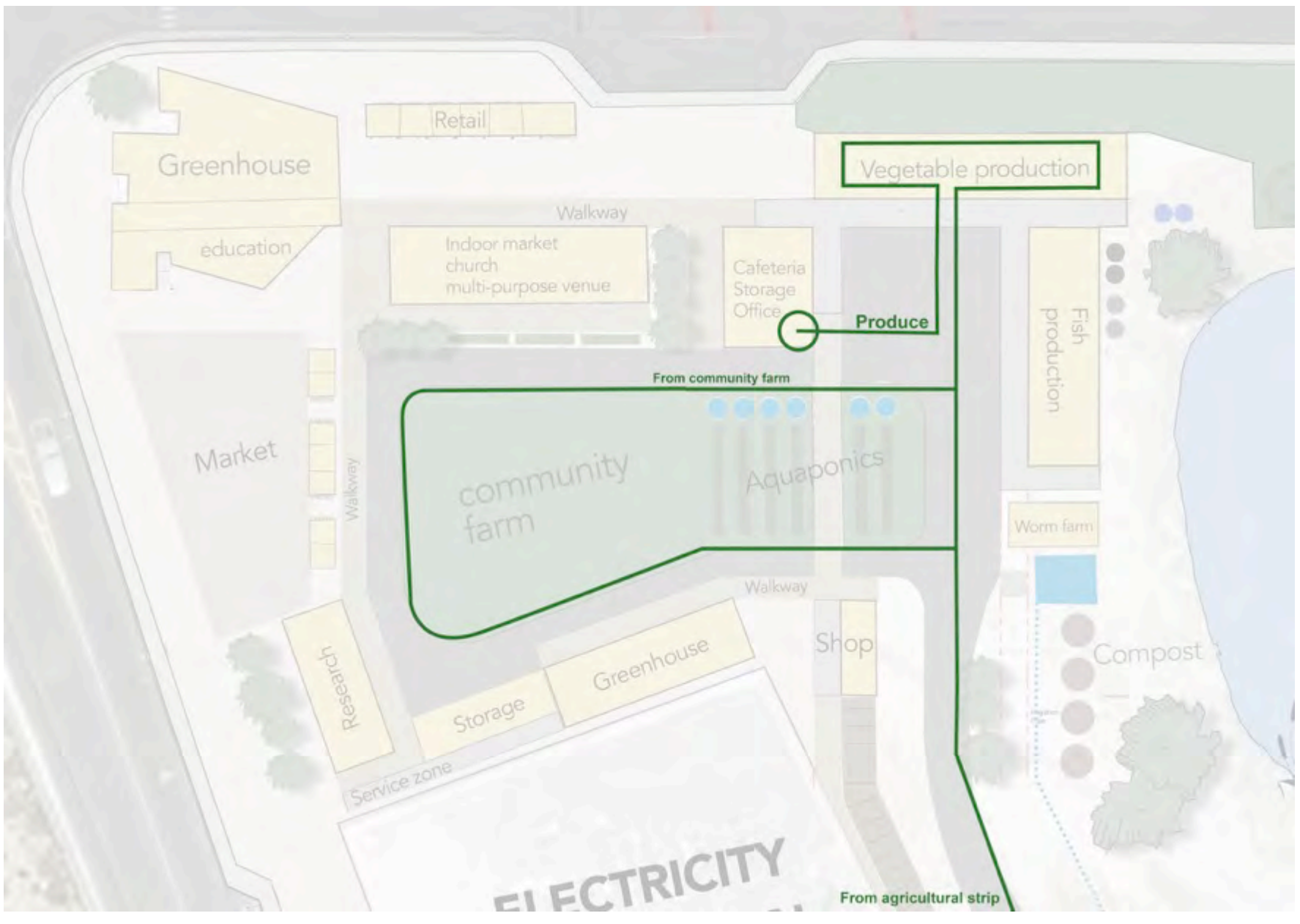


Image 75: Produce harvesting and production route. Note: produce stored on site.

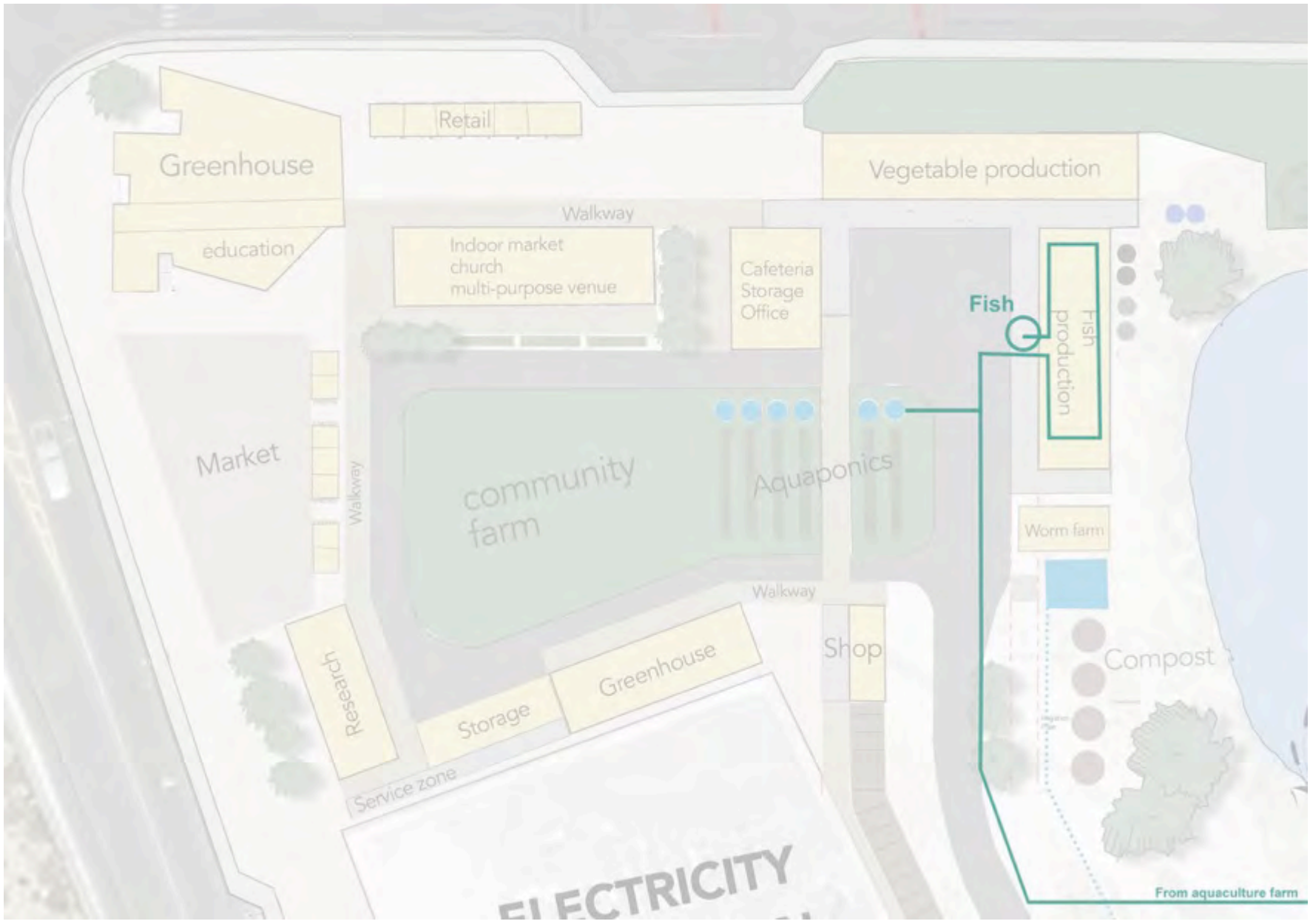


Image 76: Fish harvesting and production route. Note: fish stored on site.

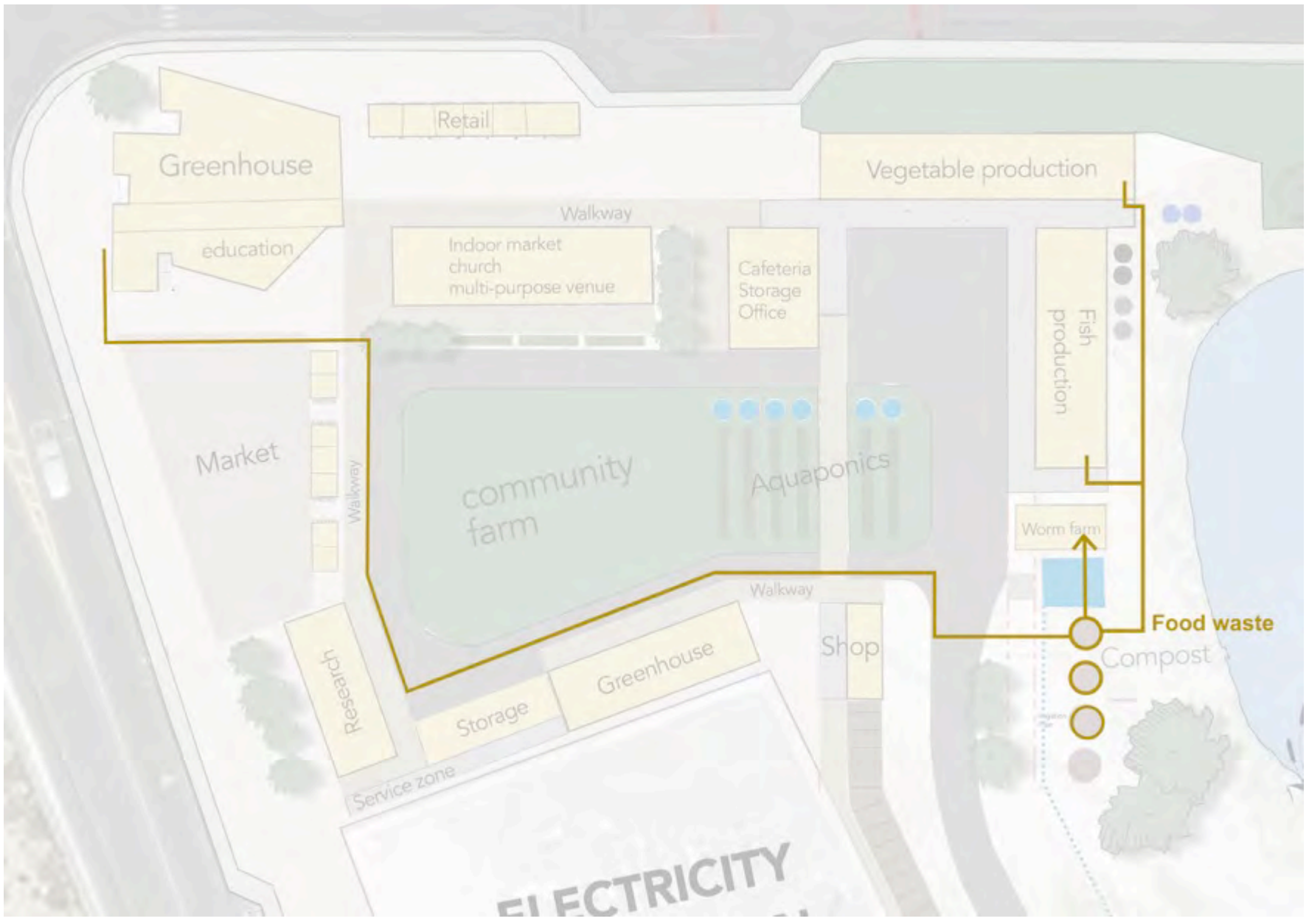


Image 77: Food waste recycling. Note: Used for making compost and feeding the worm farm.

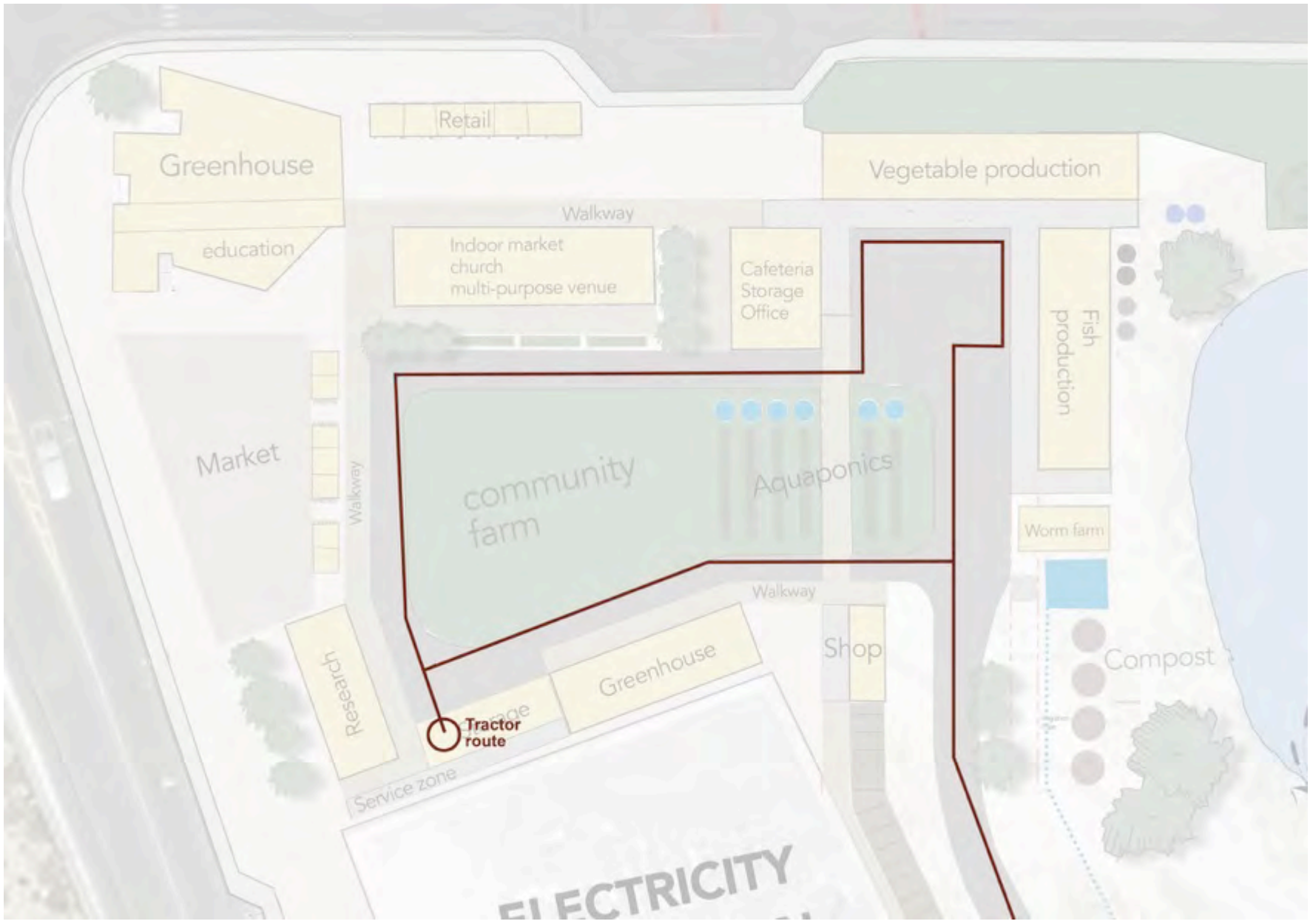


Image 78: Tractor route. Note: Used for picking up produce and distributing tools and compost when requested.

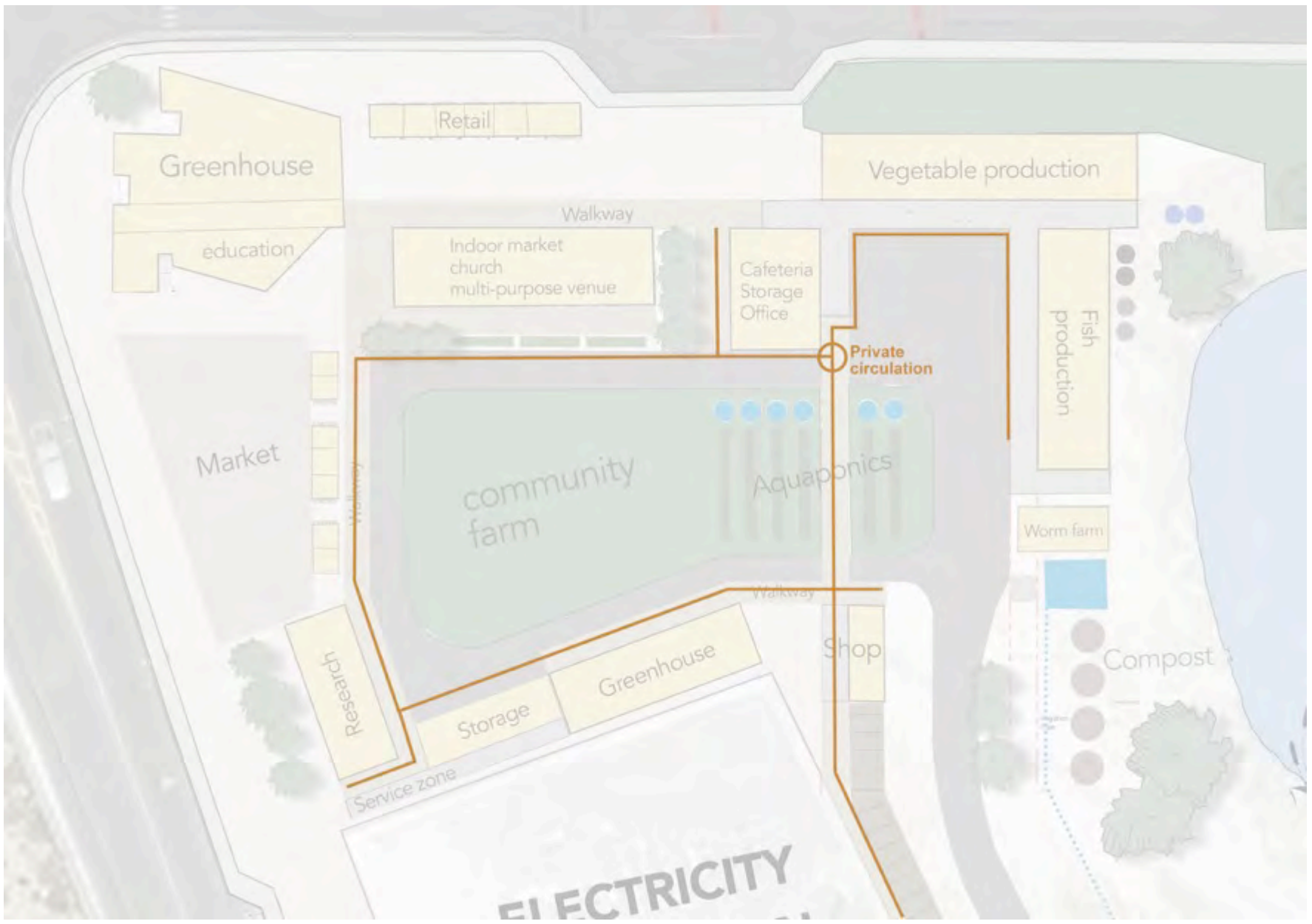


Image 79: Private circulation. Note: Used by employees.

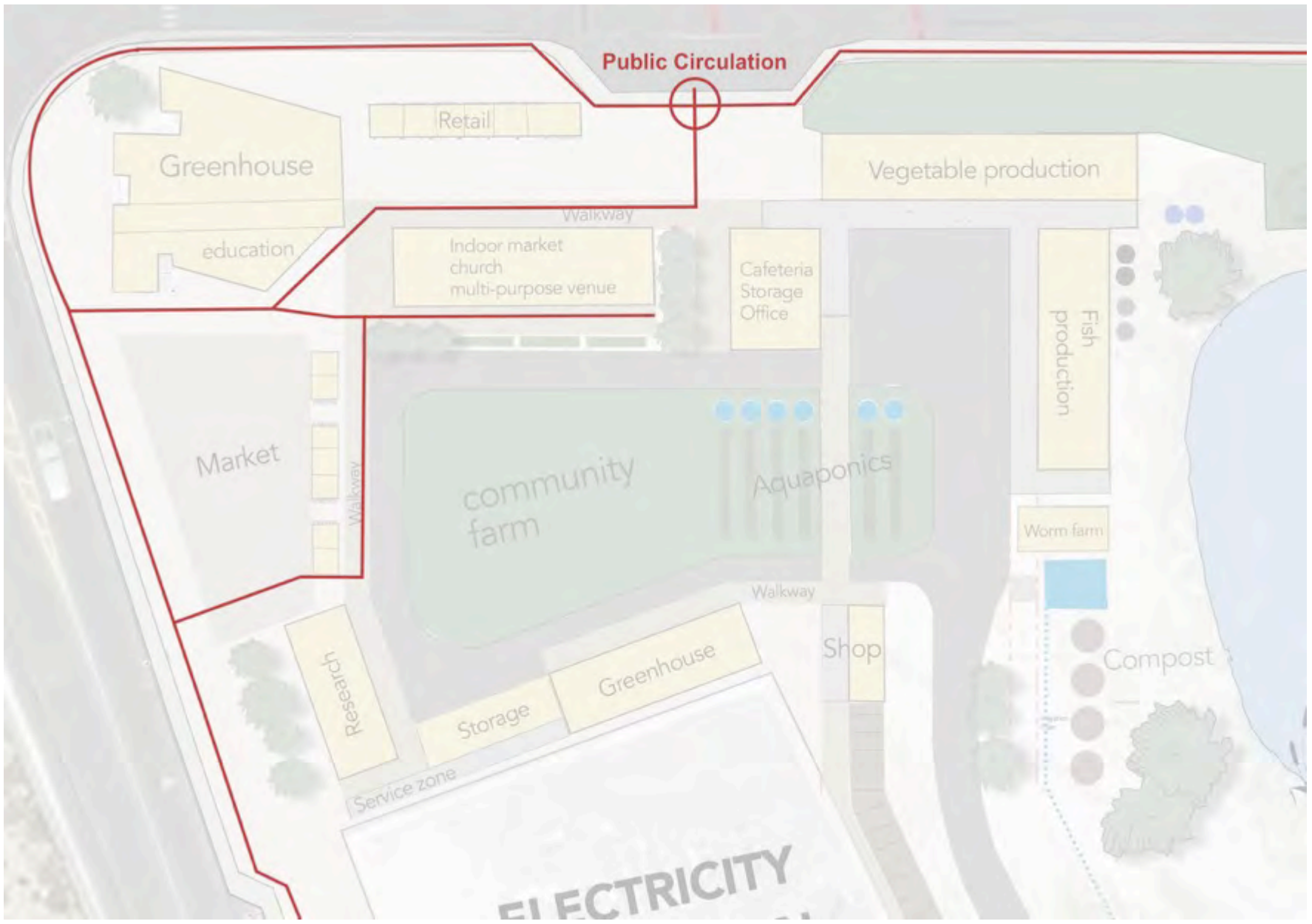


Image 80: Public circulation. Note: Access into Delft South from the MyCity bus stop and taxi drop-off.

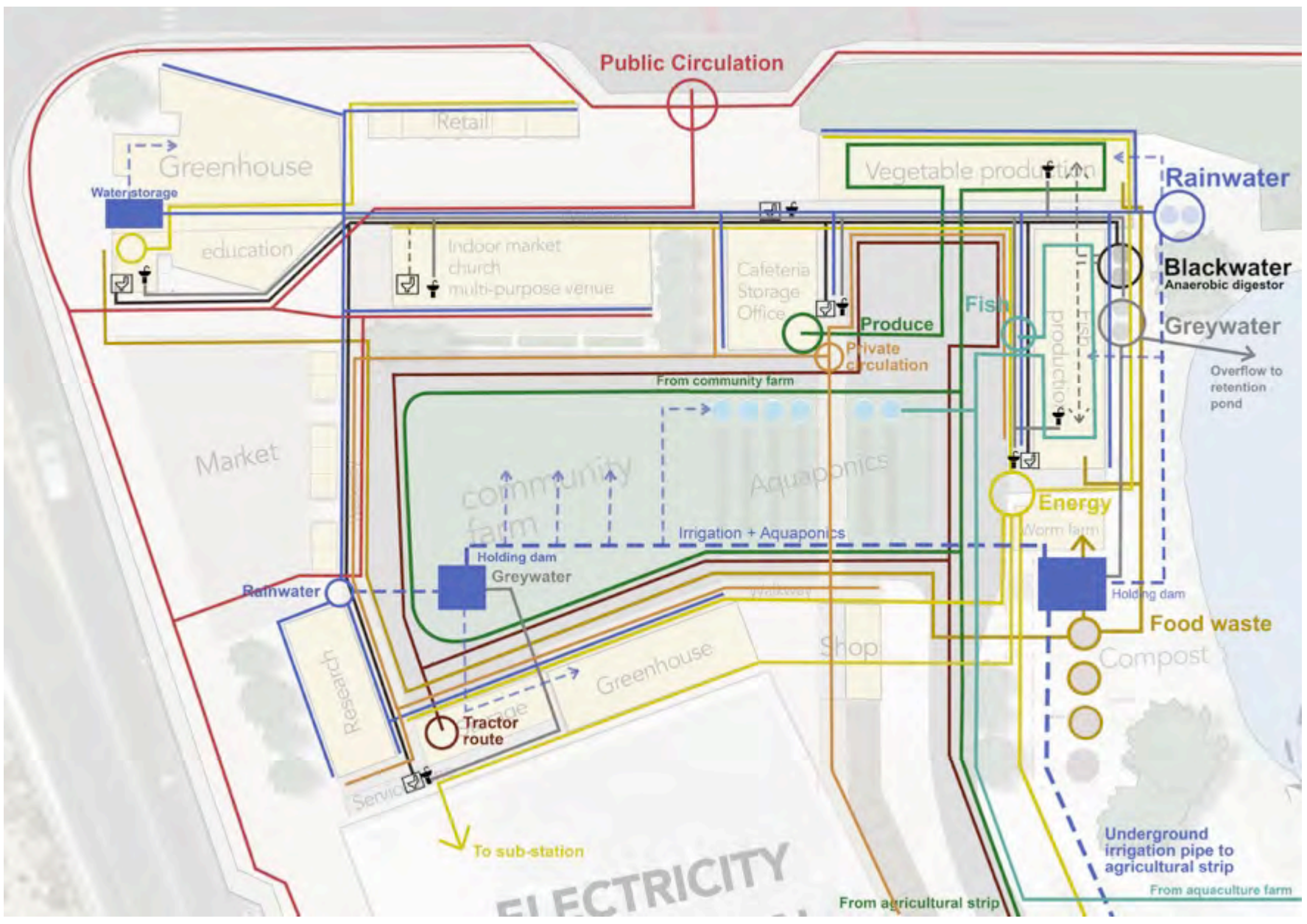


Image 81: All systems overlaid showing the structure of programme and how the systems informed and articulated the layout of the site

The Barns

Reflecting on traditional farm architecture, it made sense to use barn like structures to contain the main programme. The barn is a simple, clean and open structure that is quite flexible in its modern sense. Great heights allow for ample storage space and good ventilation while a pitched roof allow for sun and water harvesting. Using these barns, I wanted to keep them open and flexible in current use and for future use, and this drove me into developing the service zone that would house all the mechanics, services and servicing components such as bathrooms, cloakrooms, cold rooms, disinfectant rooms, off-loading areas, refuge areas and storage.

The roofs are shaped to harvest maximum rainwater and sunlight, depending on their orientation. I worked with 60 degrees for sun harvesting as the average sun altitude at solar noon was between 55 and 60 degrees. This would allow for maximum sun harvesting throughout the year. The flatter slope would be 30 degrees, creating a bigger surface and allowing for maximum rainwater harvesting into the service gutter from where it is moved to storage tanks on site.

The construction assembly of these sheds mainly consists of steel portal frames with glass and brick infill. The service core would consist of brick walls and a pre-cast concrete roof gutter that gets assembled on site. This language would be repeated in my mega structure where the greenhouse would be constructed mainly from glass and steel while the service zone, filled with programme, would consist of brickwork and concrete. All brickwork and systems are to be exposed where possible.

The basic configuration for all my buildings follows the served and servant dynamic where the served area consisted mostly of open spaces inhabited by people and the servant area is mostly occupied by services and more rigorous applications.

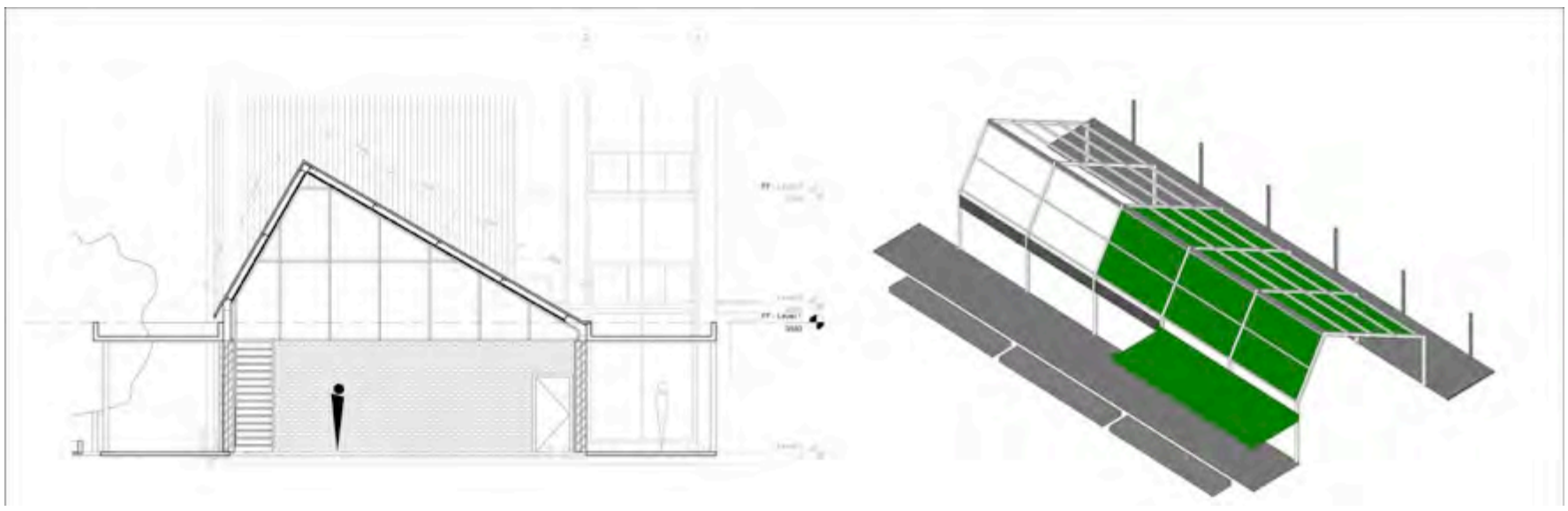


Image 82 & 83: The barn construction with adjacent service zone

The Greenhouse

The mega structure would be a working greenhouse showcasing all kinds of food growing technologies and systems. These would inform the architecture and the spaces inside. This structure is more radical than the barns on site and should read as a massive food-growing machine. The building is divided into a service zone, a programmatic core, a circulation core and a large greenhouse atrium space.

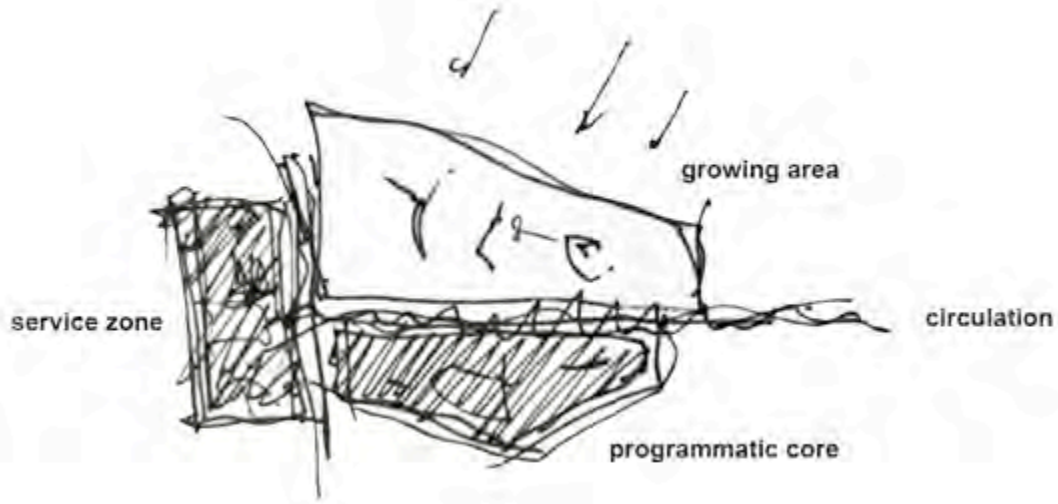


Image 84: Diagram of the greenhouse

The service zone houses circulation, a service lift, administration, water storage and a service core containing bathrooms, storage, a DB-room, ducts and a refuse area on ground floor. The programmatic core houses all the programme across 5 floors and includes a kitchen and cafeteria on ground floor, a seed laboratory and seed bank on the first floor, a library on the second floor, seminar rooms and studios on the third floor and offices and staff cafeteria on the fourth floor. The fifth floor is primarily used for services, water storage and roof access. This programmatic core is mostly glazed to the South, allowing for lots of natural light and great views of the farm and market.

The food growing area also ranges from the ground floor to the sixth floor with concrete planters on every level. These planters span between the Southern block and the structural Northern façade with a large atrium space in the middle. There will be deciduous trees on the ground floor growing in the atrium space. These trees will not only provide cooler air and shade in summer, but also provide a forest-like interior and cleaner air.

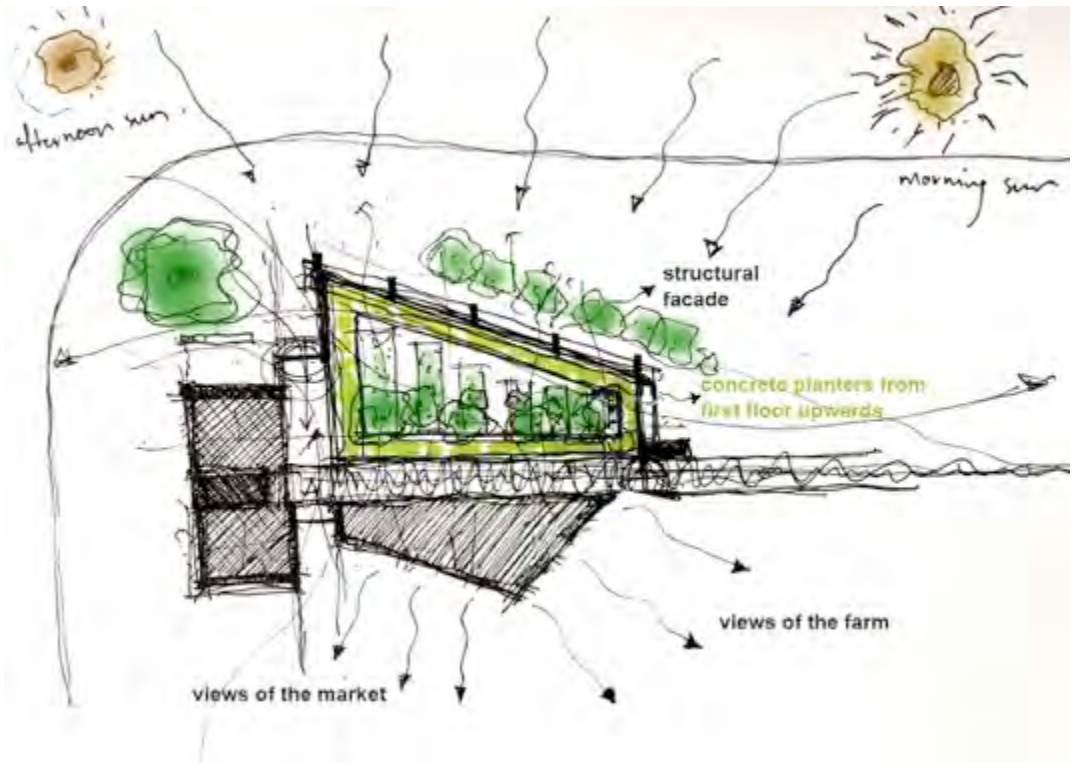


Image 85: Concept sketch for greenhouse.

One of the key components of the building is the structural northern façade. It consists of 5 large steel trusses that support the operable glass façade, the roof, planters and a walkway for access and servicing. The walkways also become an educational route through the building up to the roof where there is a spectacular view over the whole farm. Glass was chosen for the façade because of its durability, low maintenance, low transmission of UV light, good heat retention properties and high transmission in the photo-synthetically active radiation (PAR) bandwidth, the light spectrum used by plants for growing.

The trusses are angled and offset from each other to allow for maximum morning sun, rainwater harvesting and to direct pedestrian flow into the site. The walkways and planters serve as louvres to block out harsh summer sun and because of the angle of the facade, they are offset and will never block the sun from the planter row below. Northern planters are supported by the structural façade, Southern planters by the circulation core while the Western and Eastern planters span between these two structural elements and they, in themselves, function as concrete beams. The circulation core is made up of a steel framed structure that supports planters, walkways, stairs and the top-end of the angles trusses.

The planters are 1m deep allowing for the growth of all types of vegetables and herbs. Shallow-rooted vegetables require 300-450mm and include leafy greens, onions and potatoes. Medium-rooted vegetables require 450-600mm and include beans, cucumbers and summer squash. Deep-rooted vegetables require 600-900mm and include artichokes, sweet potatoes, tomatoes and asparagus.

Favorable plants to be grown in the greenhouse include, and are not limited to, peppers, tomatoes, cucumbers, summer squash, carrots, Swiss chard, leafy greens, micro-greens, spinach, chilies, raspberries and lettuce. Herbs to be grown would include basil, watercress, coriander, chives, cilantro, oregano, parsley, chamomile and lavender. The trees on the ground floor would also be fruit bearing and include lemon-, orange-, apple-, nectarine-, pear- and peach trees.

The seed bank and seed museum on the second floor will be a controlled growing environment where seedlings and specialized and rare seeds will be grown under optimal conditions in hydroponic containers and under lights. The success of these plants is of utmost importance to protect and re-establish these rare plants and once the seedlings are big enough, will be transferred to the greenhouse planters and the farm on site.

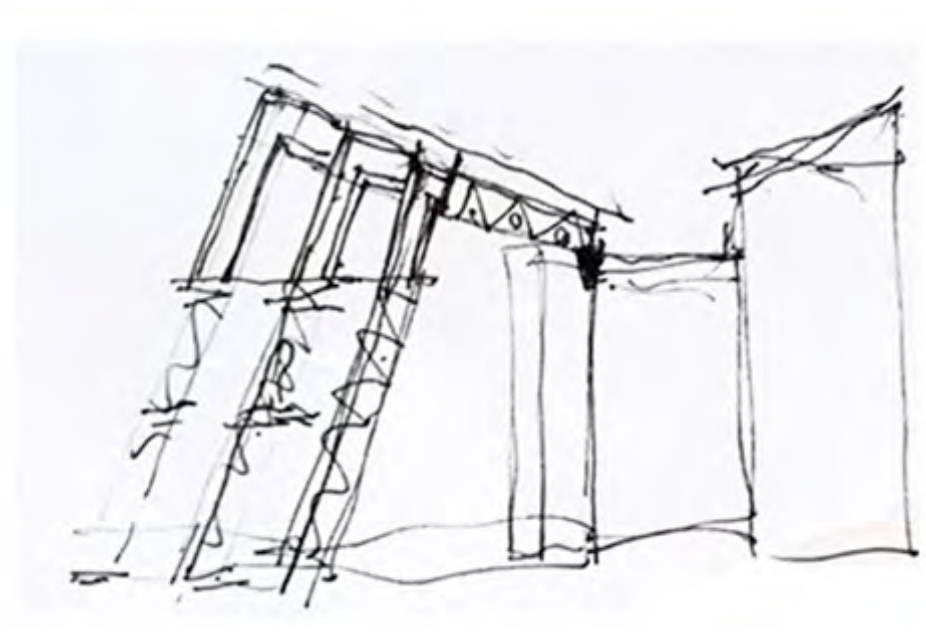


Image 86: Conceptual sketch of the structural façade trusses.

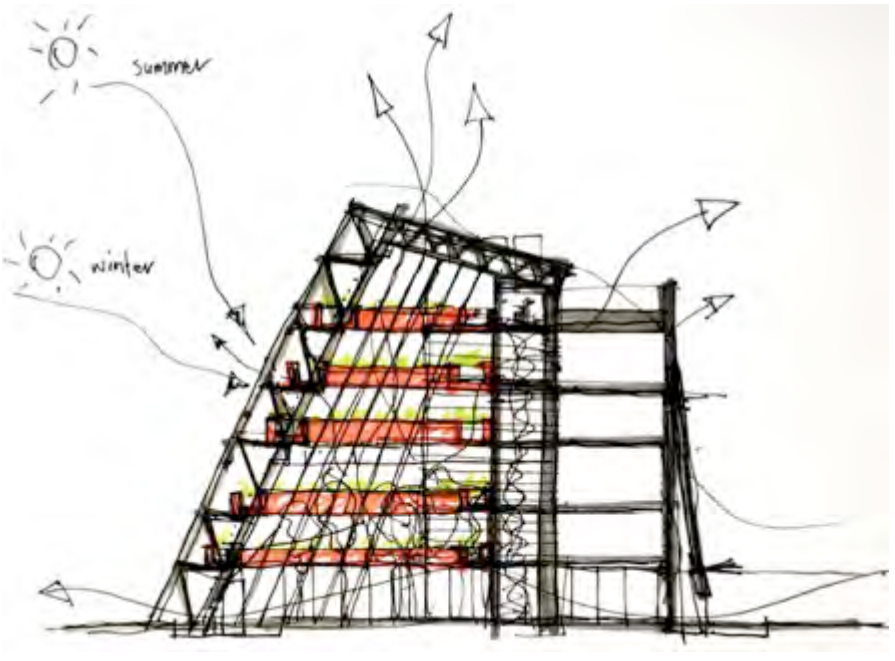


Image 87: Concept section with planter boxes in red

The façade and the roof are angled to allow for maximum rainwater harvesting. Water from the façade falls into a water dam and is fed into a holding tank inside the building. Water from the roof falls into a service gutter and is channeled down into the same holding tank. From here, water is pumped up to the 6th floor where it will be gravity fed to all planters in the building. This storage tank will supply water for all the water requirements in the building that include heating, cooling and irrigation while excess water will be fed to site. The flat roof of the programmatic core is populated with solar panels to generate electricity for the pumps and the everyday building activities. Excess energy will be fed into the grid.

Passive ventilation, fogging and plants will regulate the climate inside the building. Cross ventilation will be used during summer months to move air while the chimney-stack effect will force hot air out through the roof vents. During winter, water will be heated by a hydronic gas boiler and then pumped into a pipe that runs along the inside of the building to heat up the structure to required temperatures.

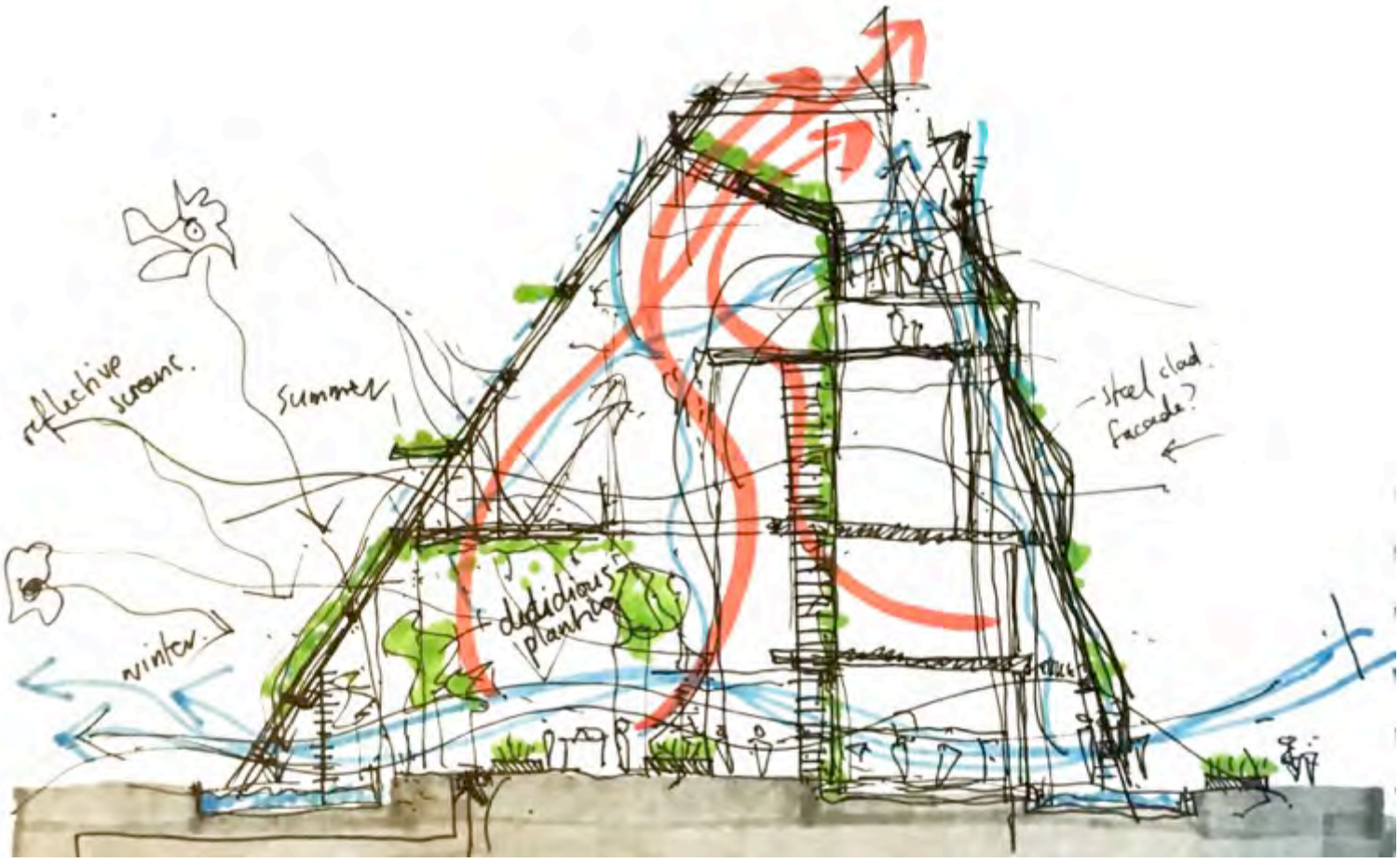


Image 88: Concept sketch of greenhouse thinking about ventilation.

The key components in establishing a successful greenhouse building are to be able to control the temperature and the humidity inside the structure. All my systems are specifically aimed at achieving is. The height of the structure is a great advantage as it allows for a more versatile space that is easier to regulate and to manage the unwanted heat during warm summer months. The fogging system that is installed on a series of cables spanning across the atrium will help to regulate air temperature and to increase humidity.

These systems all combine to create a favorable space for growing plants and for human inhabitation and would become a place to learn and experience all these technologies first hand. The greenhouse building would become a landmark for Delft and its surroundings, a functional building that wears its systems proudly and becomes a catalyst for future buildings where plants and people can live and work in harmony and benefit from each other.

Phasing, occupation, funding and development

The project will be zoned to allow for multiple investments. The infrastructure for the agricultural strip will be the first investment allowing the agricultural aspect of the project to take flight. Elsenburg will be the investors for this and also for all the other agricultural related infrastructures such as the tractor route, the irrigation system, the borehole and pumps, the holding dam, a tractor and some tools.

I would attempt to get the production yard funded by the government so I can approach possible private investors and social businesses with lucrative offers of low rent and available infrastructure. The vegetable production operation has already attracted interest from Abalimi Bezekaya. Rob Small stated that if they can obtain the pack shed at a reasonable rate with the available infrastructure and farms they would be very interested to take ownership of that space. The same for the fish farming operation, I've approached Alan Flemming (founder of "The Fish Farm") who currently runs various aquaculture operations across South Africa and he was confident that he could take ownership of the aquaculture setup and run the fish operation on a commercial level. The church and indoor market will be available to the community and I would be looking for local investment while the research facility would again, be available for private investment. The public greenhouse building would offer great financial opportunities being one of the first vertical commercial greenhouses in our country with sustainable low input, high output energy at the forefront.

The whole project could be phased if investment is difficult to acquire at first, to allow the operation to get started and trusted names to be affiliated. As the production yard begins to blossom and the different organizations start to make money, employ people and eventually start paying full rental fee's and municipal rates, the whole operation would become a very lucrative investment, not only because of its innovative and fresh take on local production, but because of its success as a business model. The ultimate aim would be to start rolling out these production yards and urban farming operations across South Africa and the world. A model that can influence the informal markets and also become a valuable player in the formal food markets with local production and sustainable operation at the forefront. A model that would inspire under-privileged people to become part of a revolution and start reaping the many benefits that local food production and farming can bring.

- Conclusion -

One and a half years after starting this journey with urban farming, I'm writing the end of my report and dissertation paper sitting here in my apartment filled with potted plants, some edible, encapsulated with the world of growing, the world where a seed can keep on giving, keep on multiplying and keep on creating life from where there was none.

I've learned so much about growing plants in this last year, about recycling and composting, about worm farming, about organic farming and about eating local plants and flowers. I've seen some amazing urban farms and greenhouses and the quality of food they grow. It is not unrealistic to think that when we start supporting local producers who don't mass-produce and manage their farms or gardens sustainably, we can grow an economy, drop prices of goods, increase the quality of goods, increase the margins and markets for local farmers and importantly, look after the earth we have.

Since I started this journey, I've planted about 200 seeds, eaten about 10kg of leafy greens, I've been learning about these plants, how much sun they like, what to do when the leaves go yellow, how much water and nutrients they require, how to keep the soil moist during warm summer days, how to grow seedlings and much more. I've encountered bees, I've encountered ladybugs and I've seen baby worms all while living on the 5th floor of a suburban apartment. I walk into my lounge everyday and look at every single plant to see if they are still happy and healthy. Once these plants start giving back to you, physically, mentally and spiritually, you start to build a connection with them. You start appreciating and respecting the earth and all its beauty and complexity and I think this is a really great feeling that can inspire people to grow more, in all senses of the word.

On the basis of all my research, the people I've met, the conversations I've had and the opportunities I've seen, I believe that this project, with all its idealistic ideas, could one day become a reality. All things considered, and with the help of communities who respect this and value it more than the parts it is physically made of, I believe that this model for growing food locally can be established and operated in countless areas around the world.

On that note, it is time for me to go harvest some rocket, baby spinach and lettuce for my dinner – my daily dose of fresh and healthy leafy greens.

Image 89-91: My homegrown produce supplying me with fresh greens on a daily basis.

- Final Drawings -

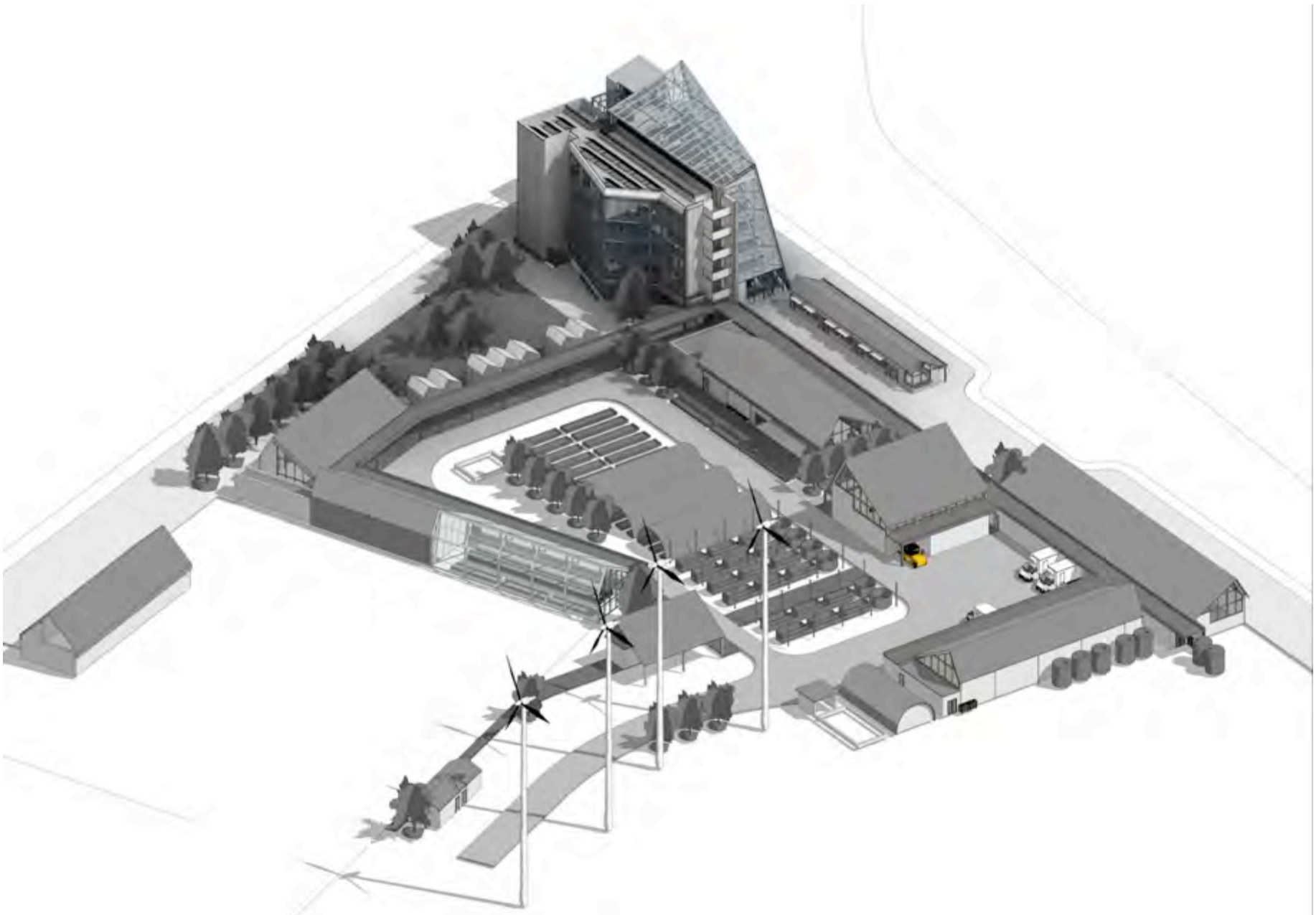


Image 92: 3D image of The Seed

Image 93: View from the MyCity bus stop towards the greenhouse

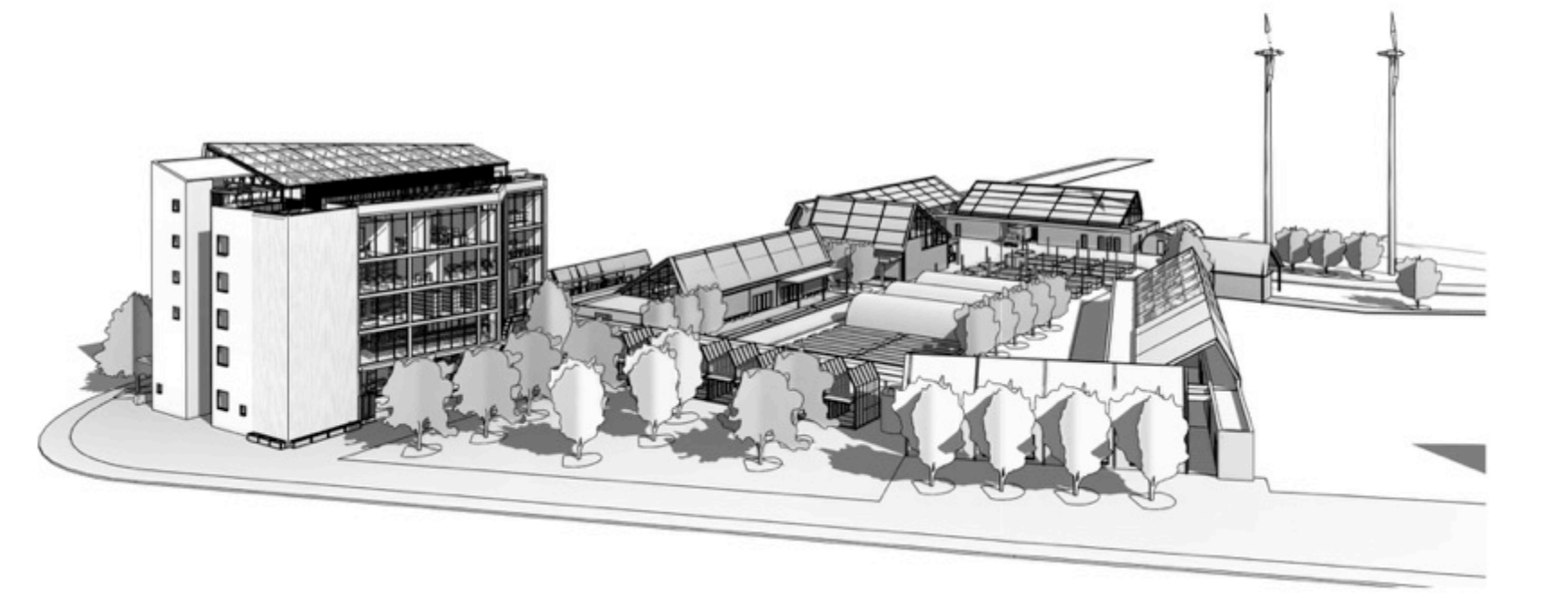


Image 94: 3D view towards the market

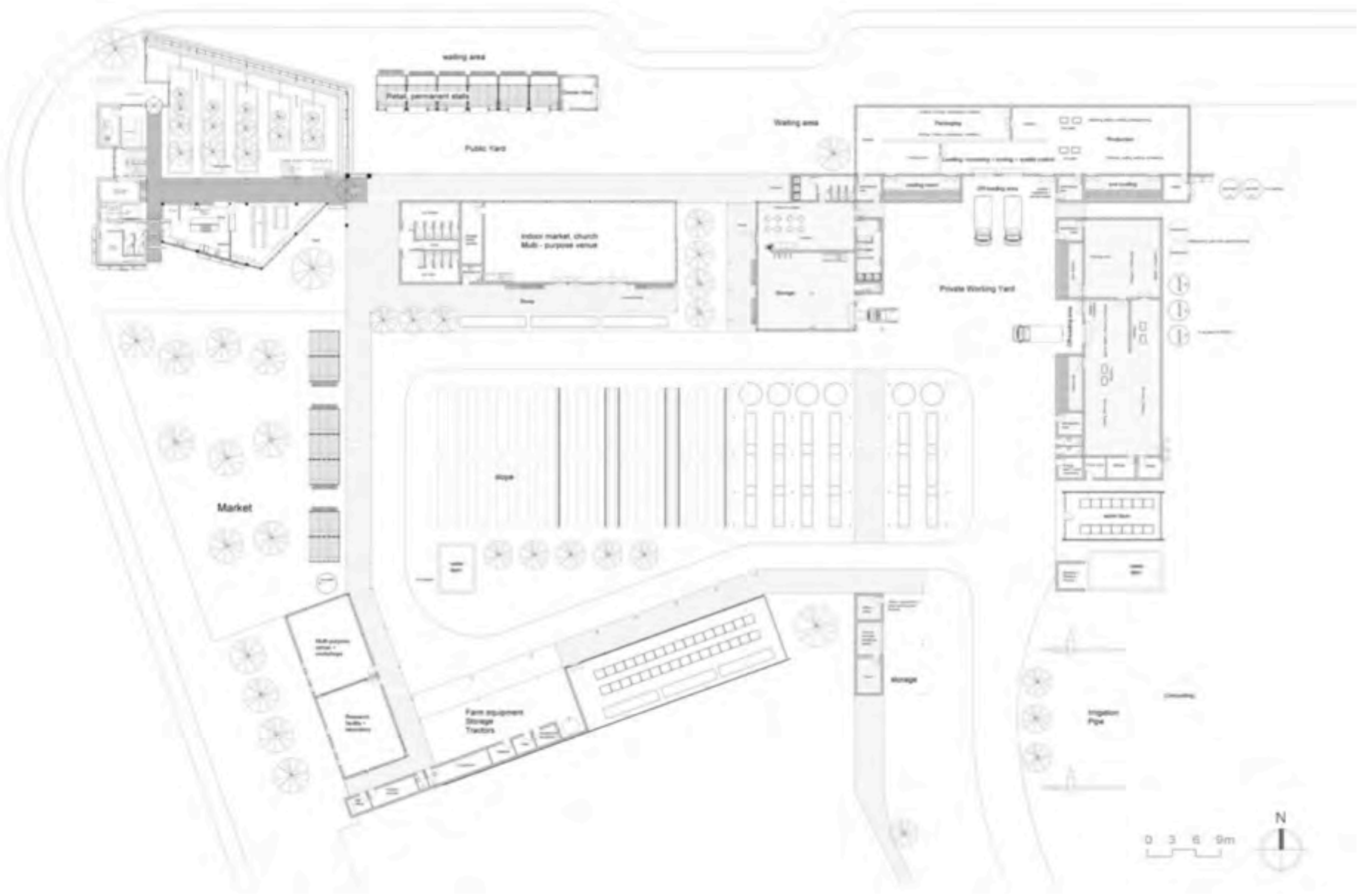


Image 95: Plan of The Seed

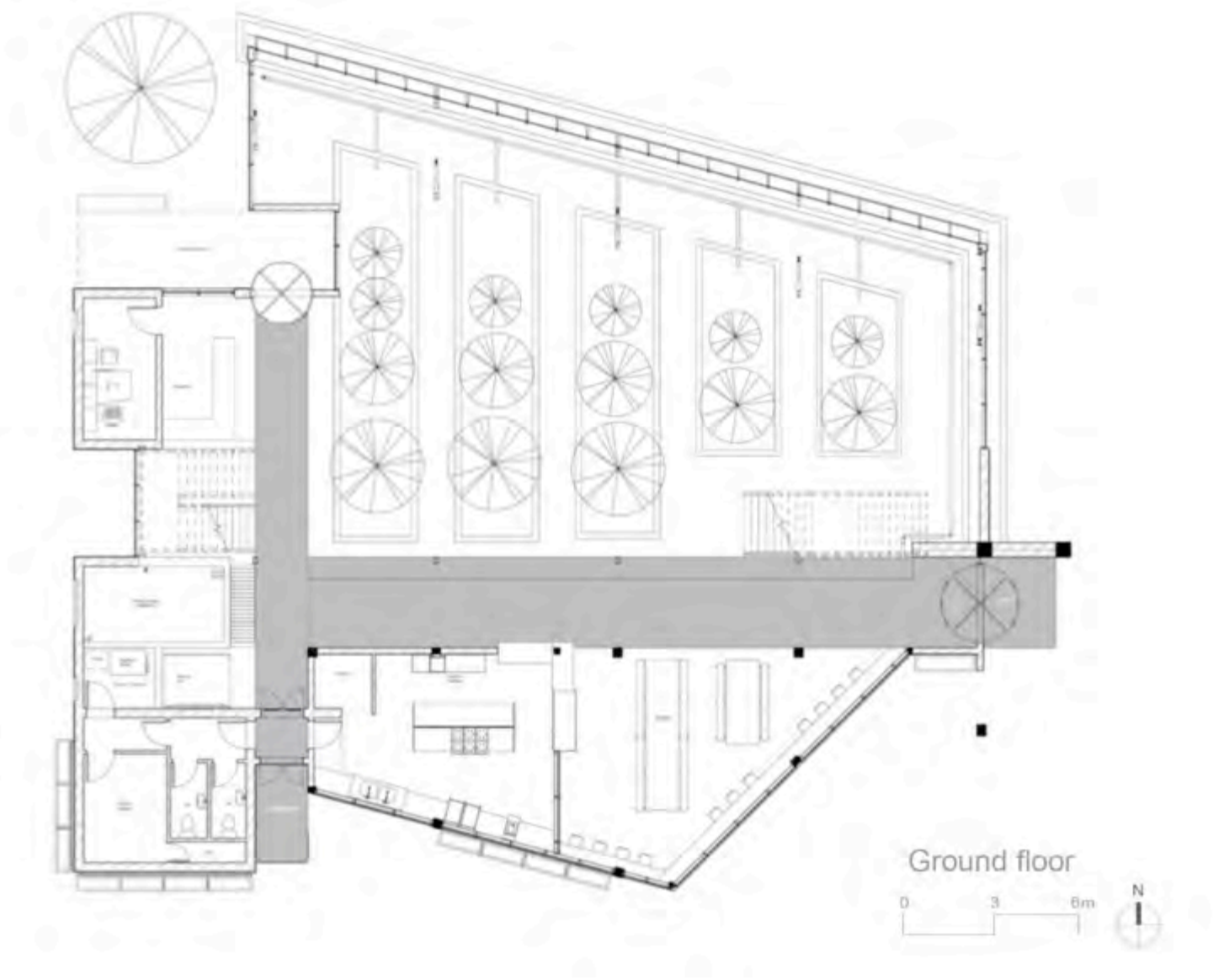
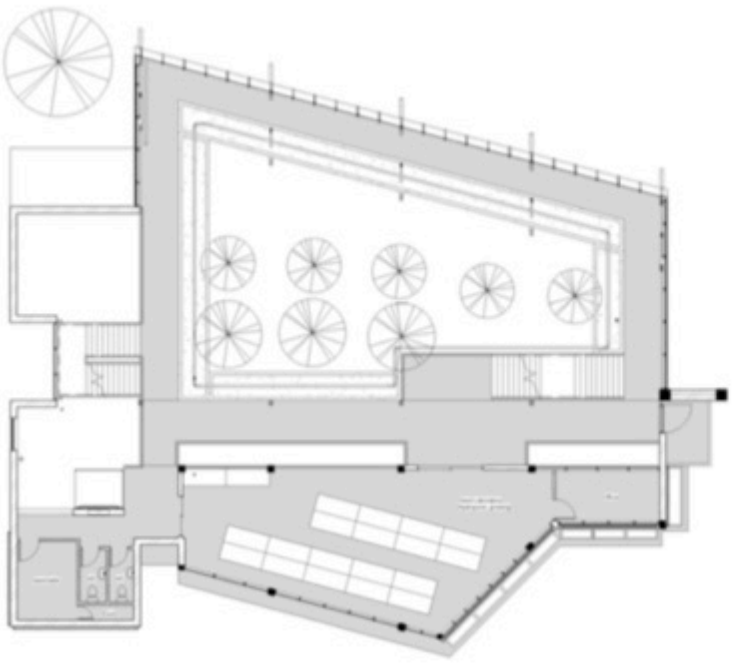
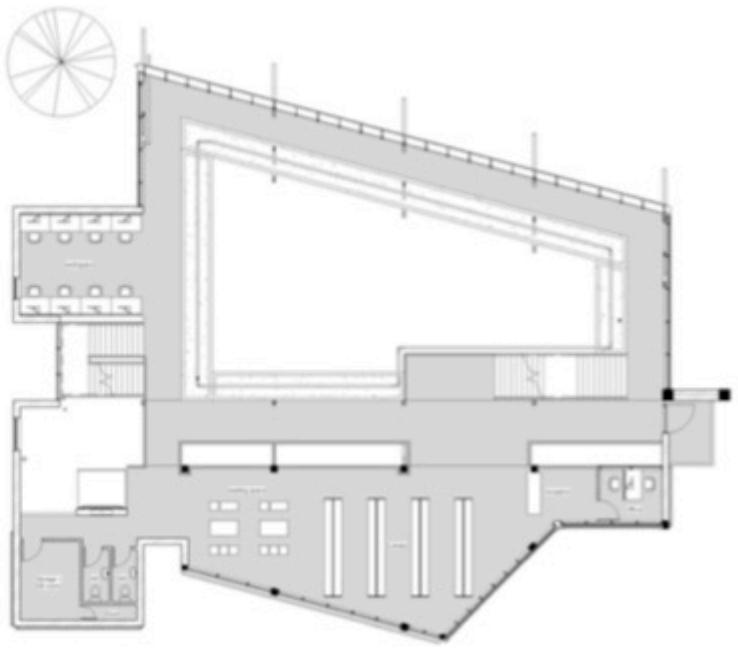


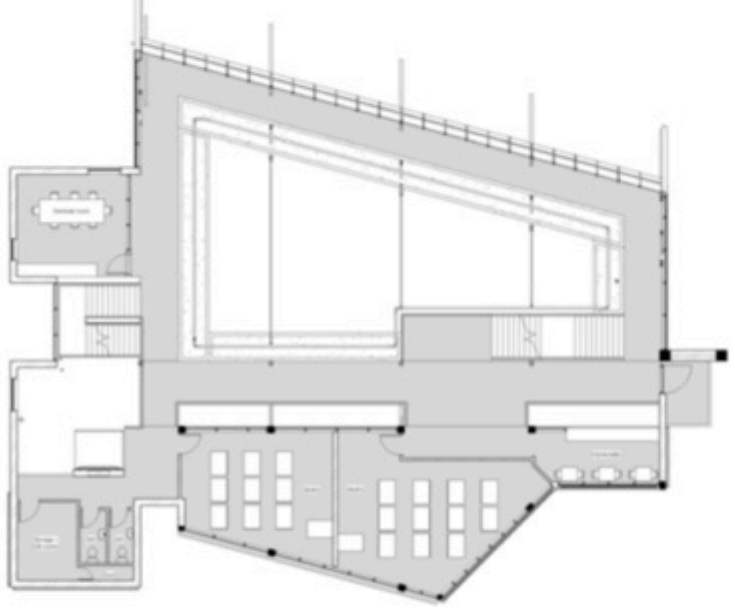
Image 96: Ground floor plan of the greenhouse



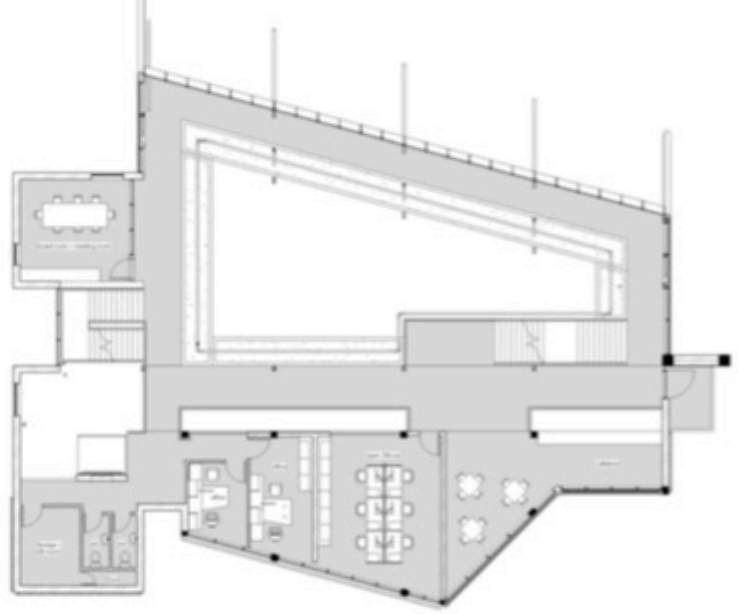
First Floor



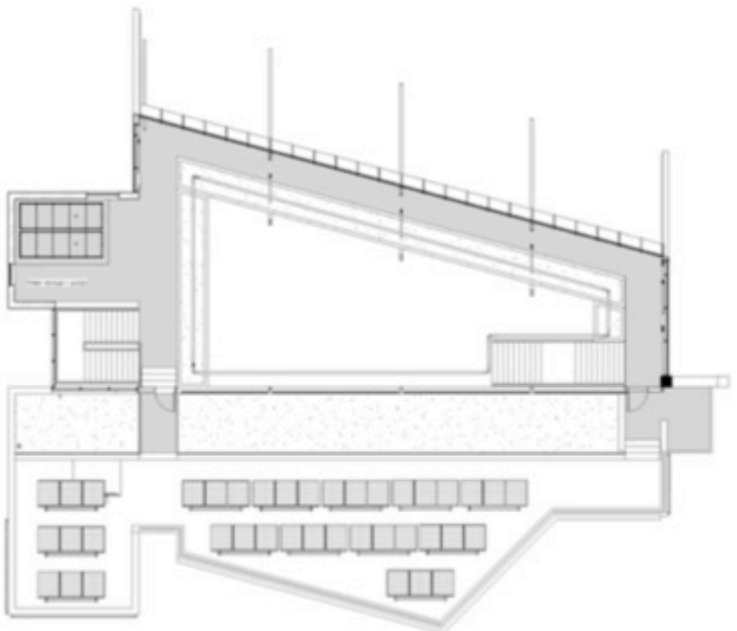
Second Floor



Third Floor



Fourth Floor



Fifth Floor / Roof plan

Image 97: Floor plans for level 2 – 6 of the greenhouse

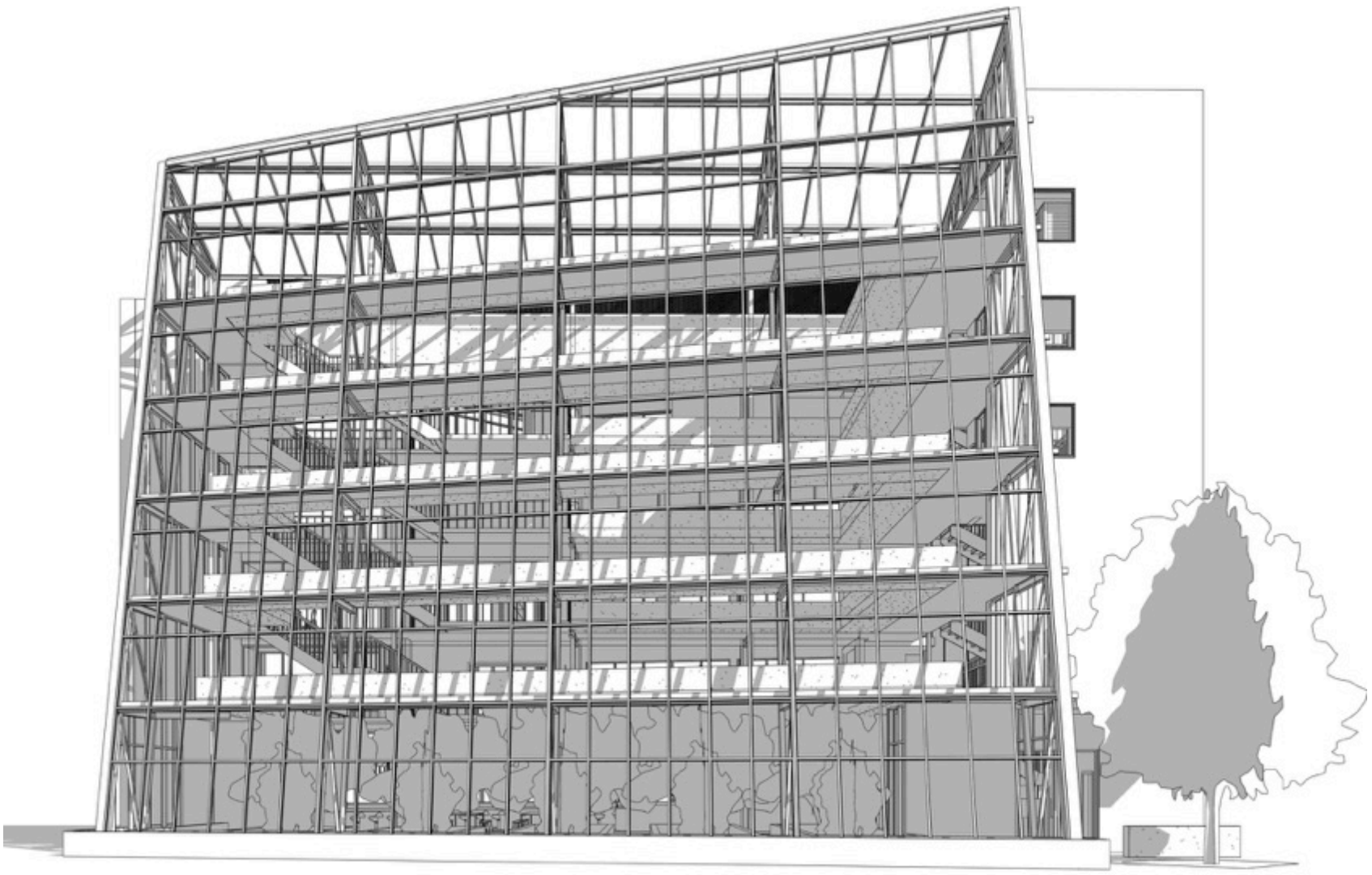


Image 98: North Elevation

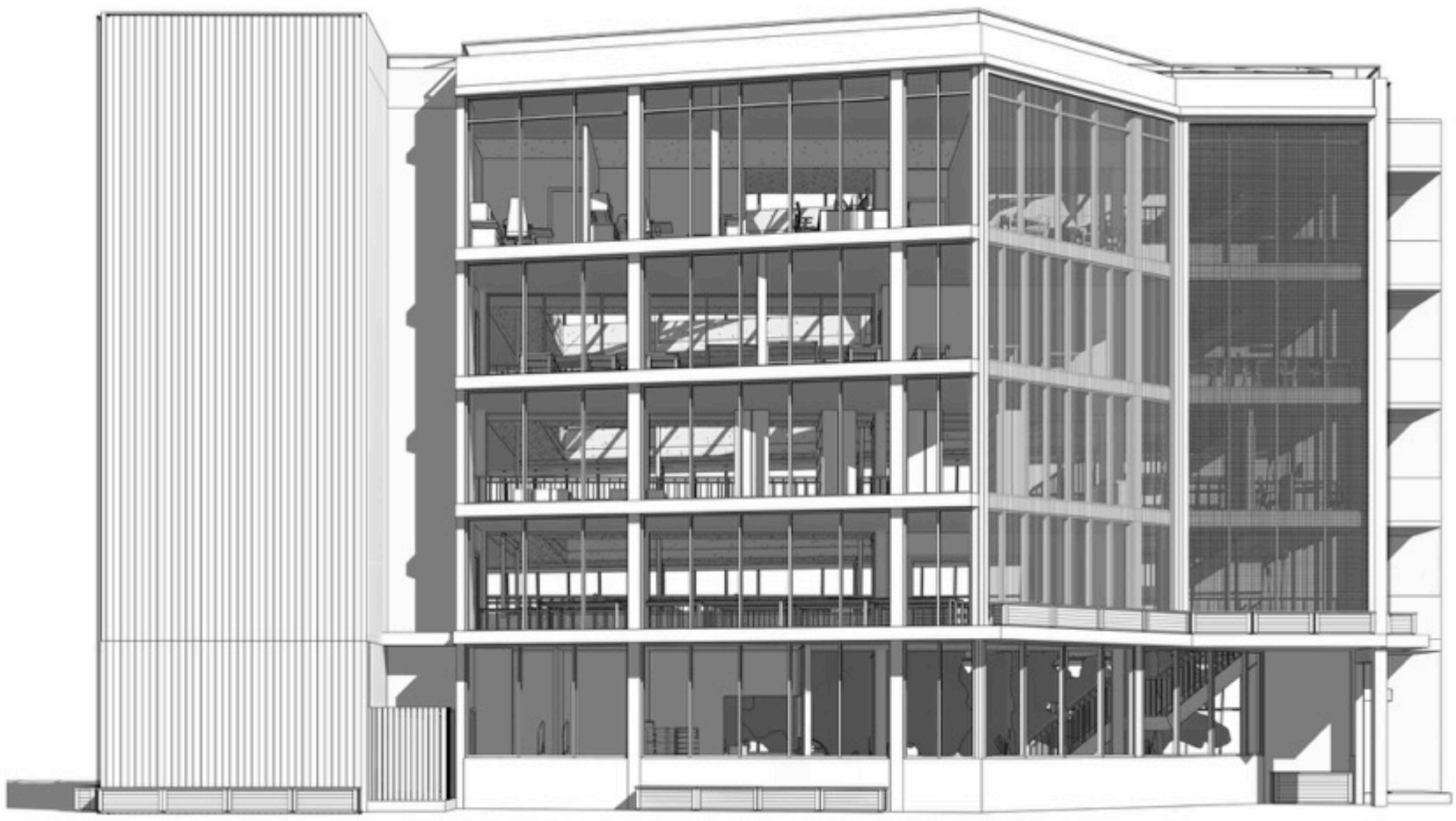


Image 99: South Elevation

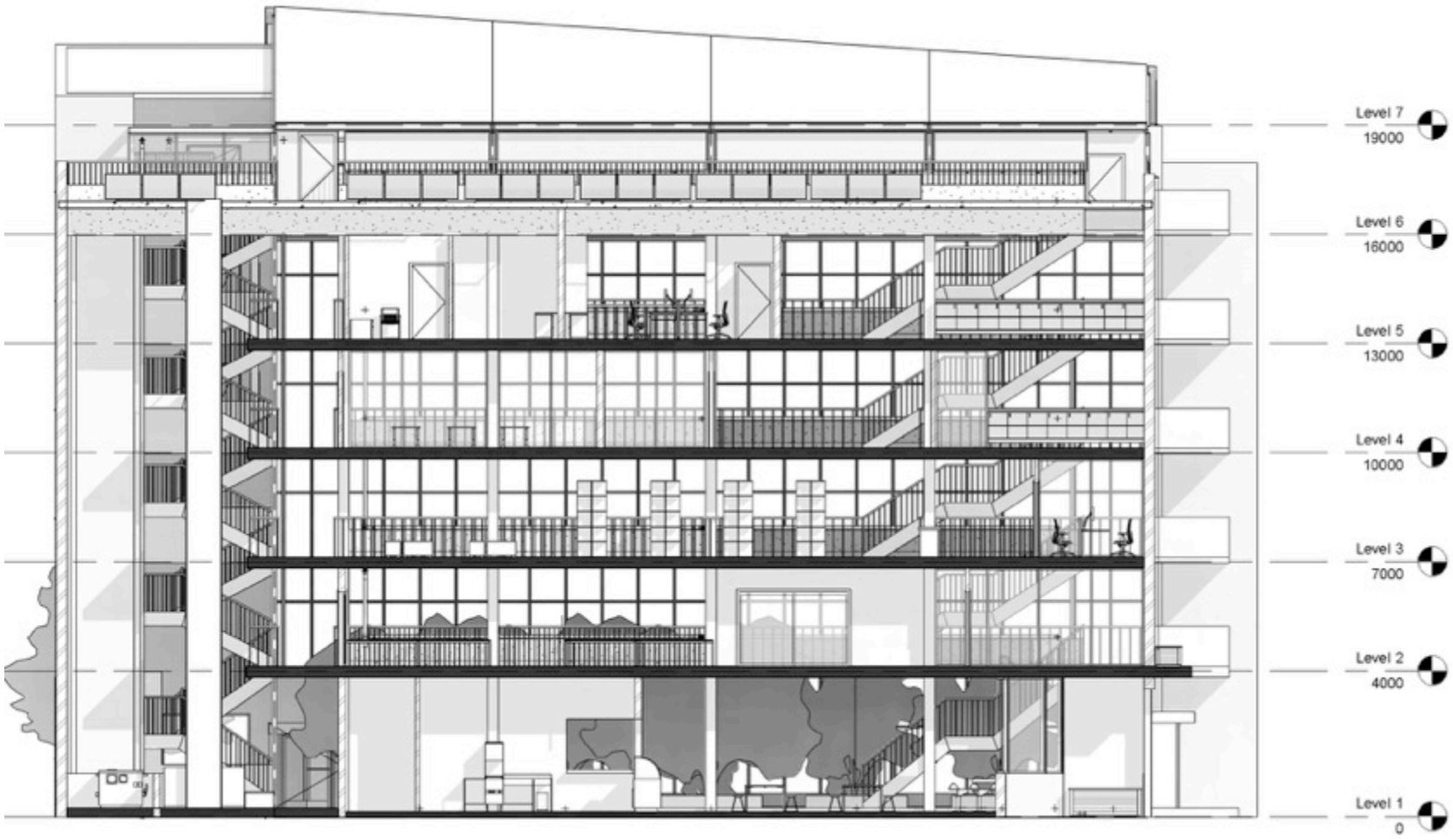


Image 100: Section through programmatic block looking north

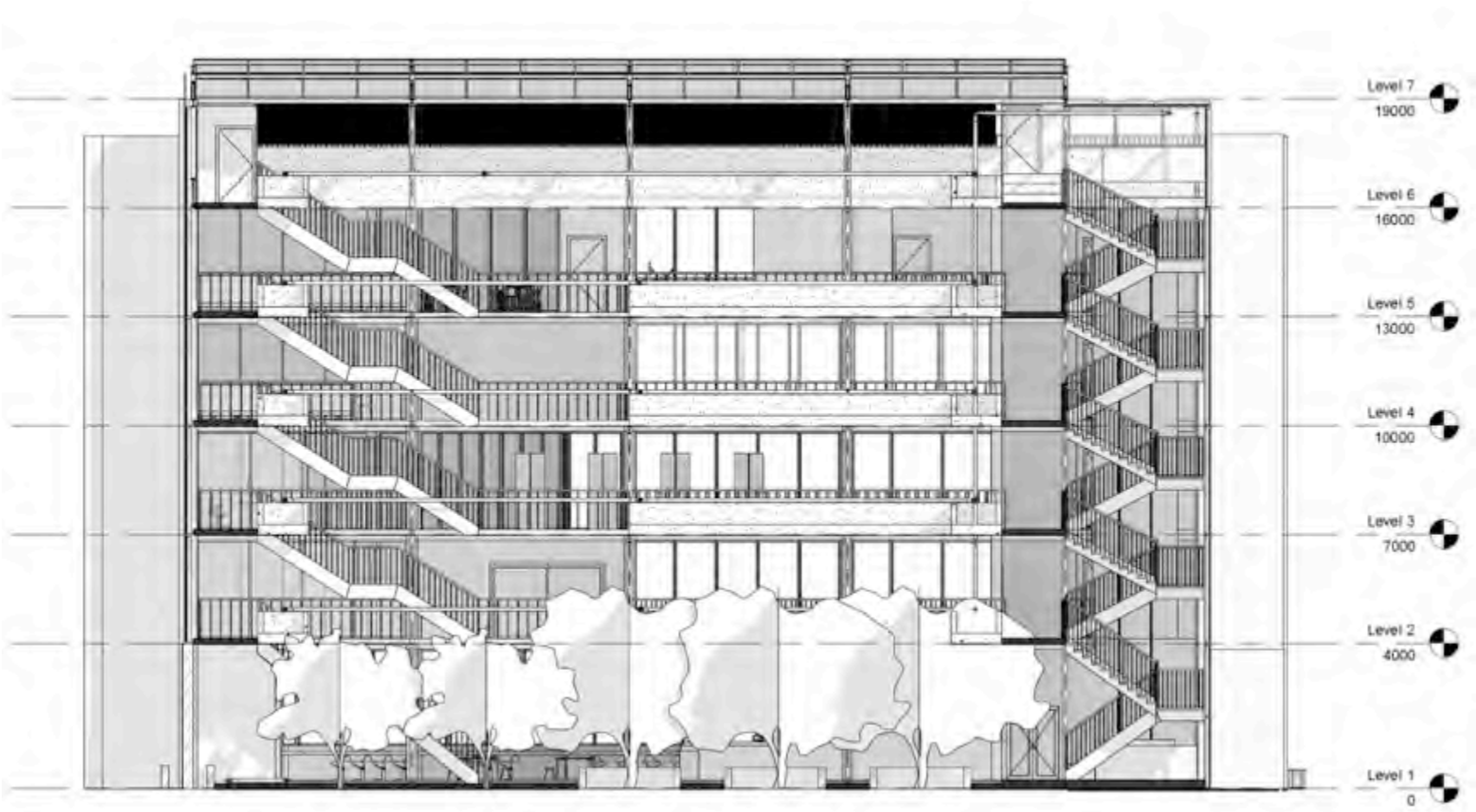


Image 101: Section through growing area looking south

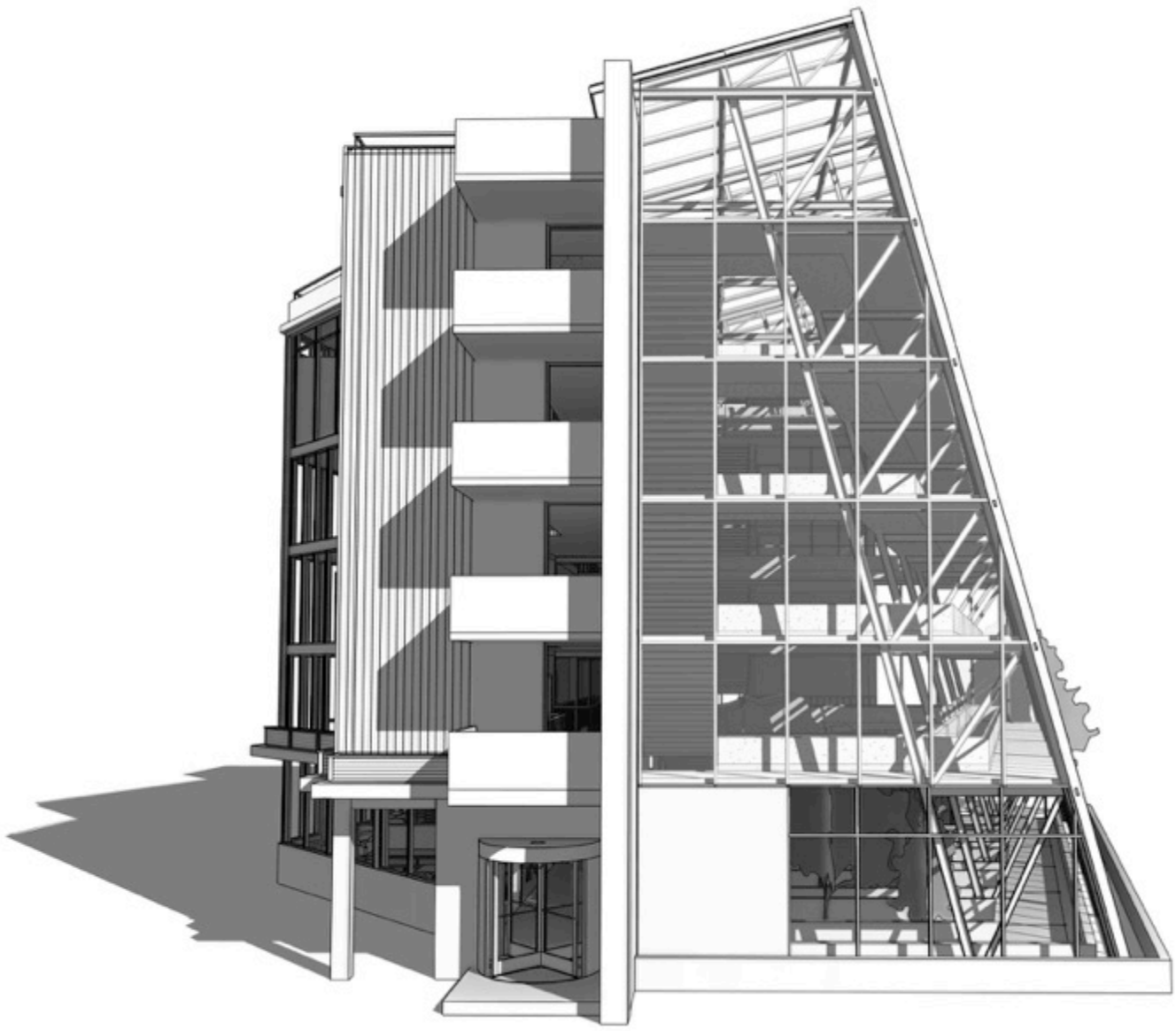


Image 102: East Elevation

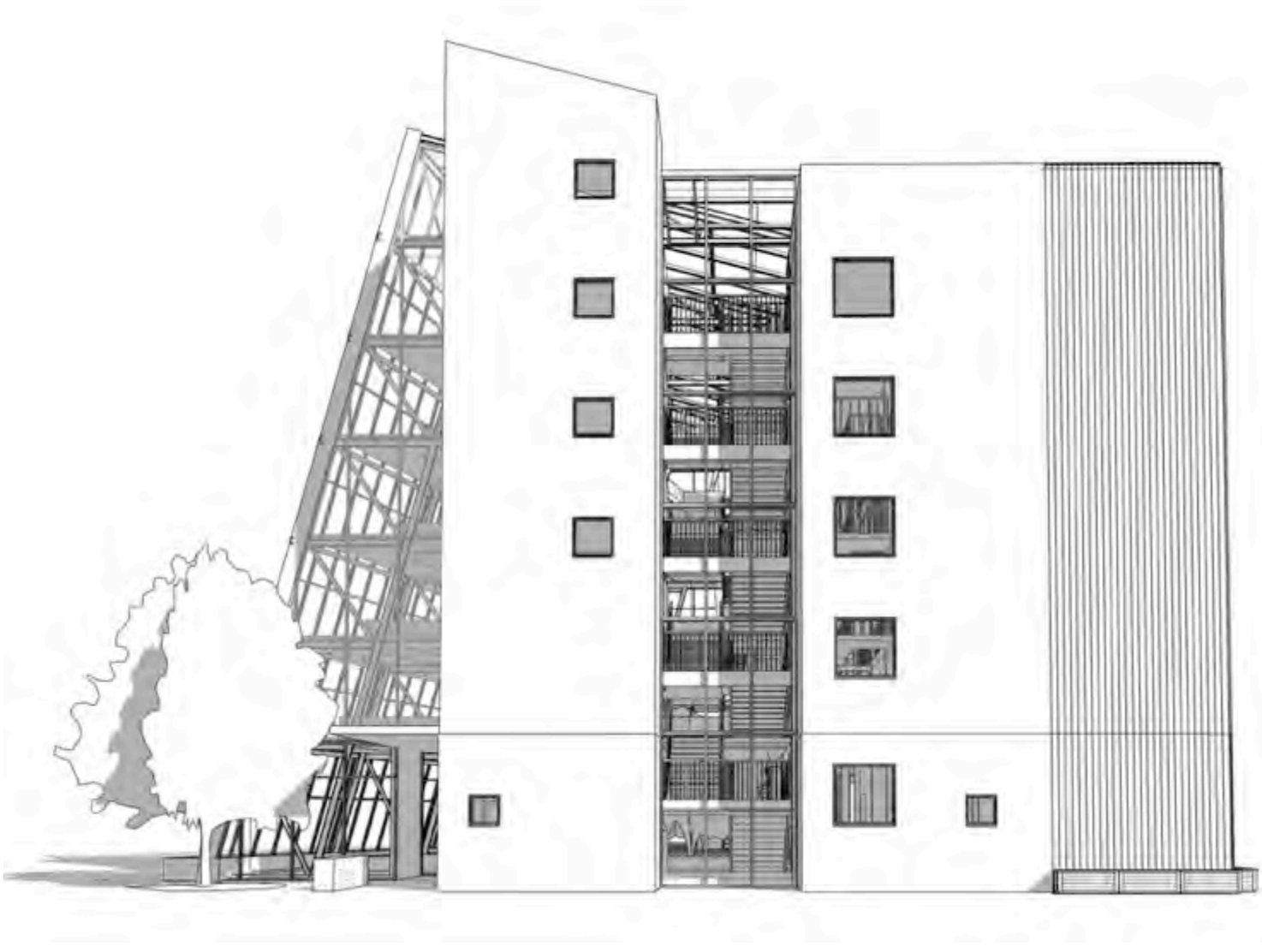


Image 103: West Elevation

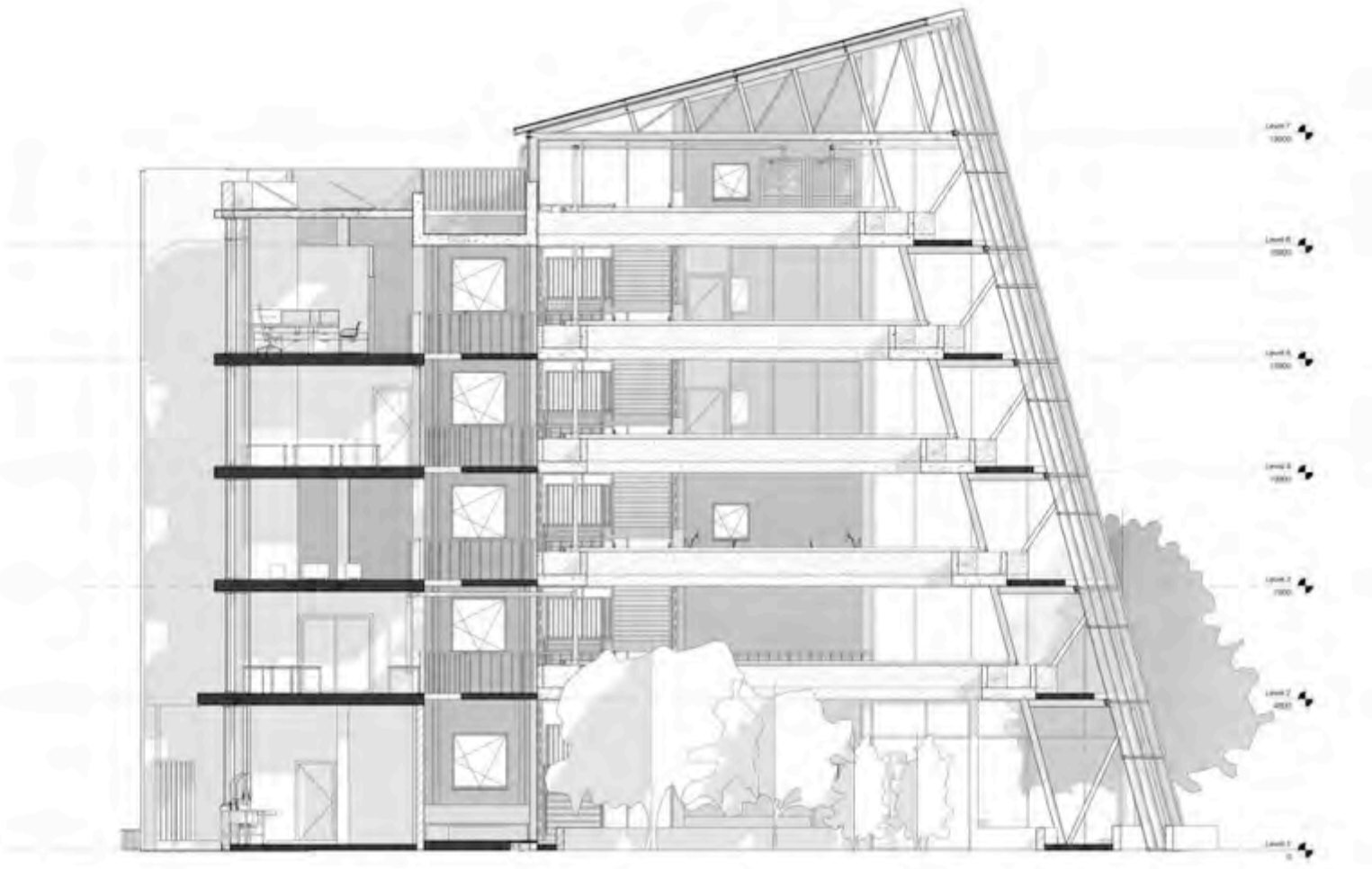


Image 104: Section looking west

Image 105: Section looking east

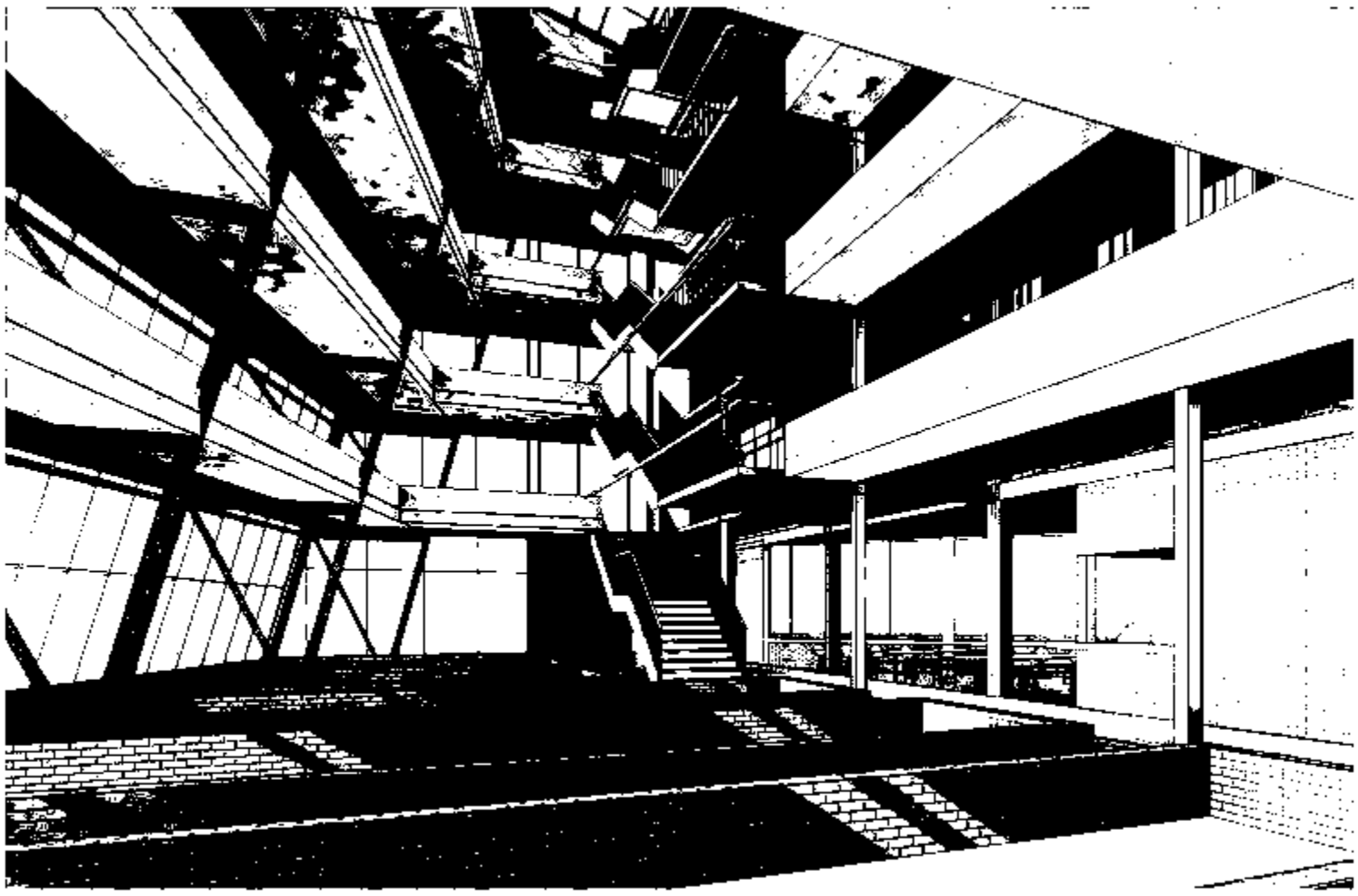


Image 106: Interior view looking towards the eastern entrance

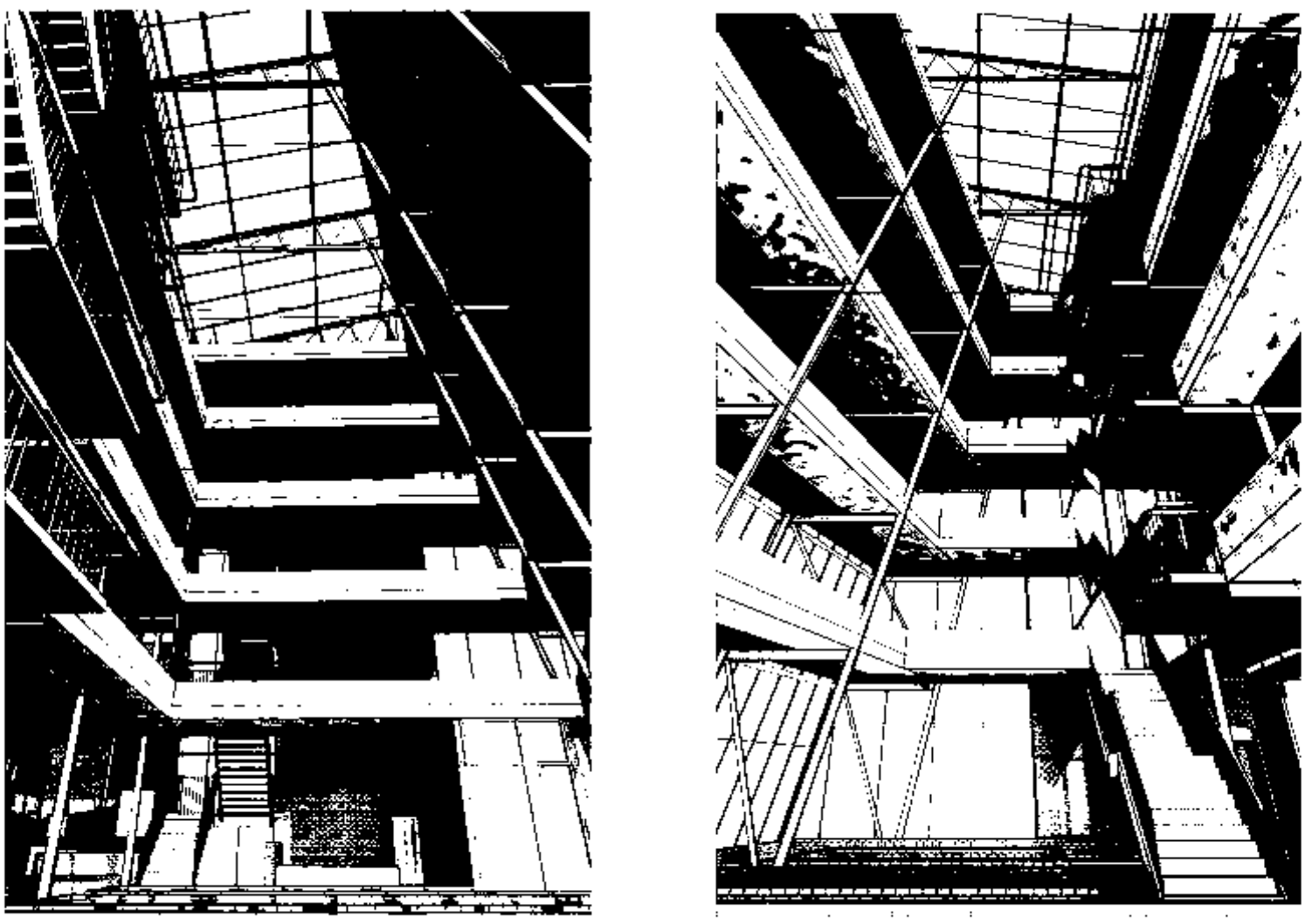


Image 107: Interior views of the atrium

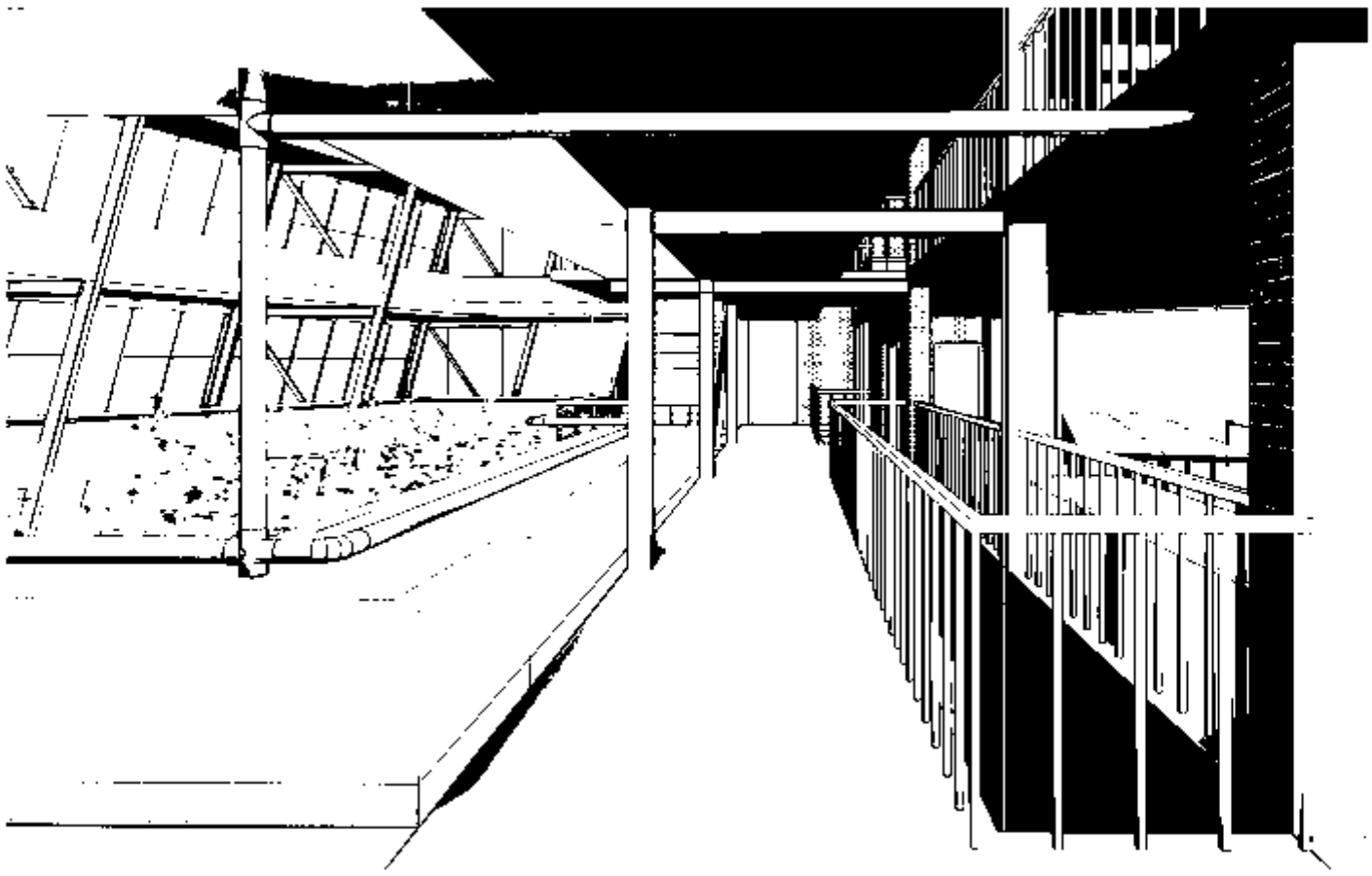


Image 108: Interior view on the first floor looking east

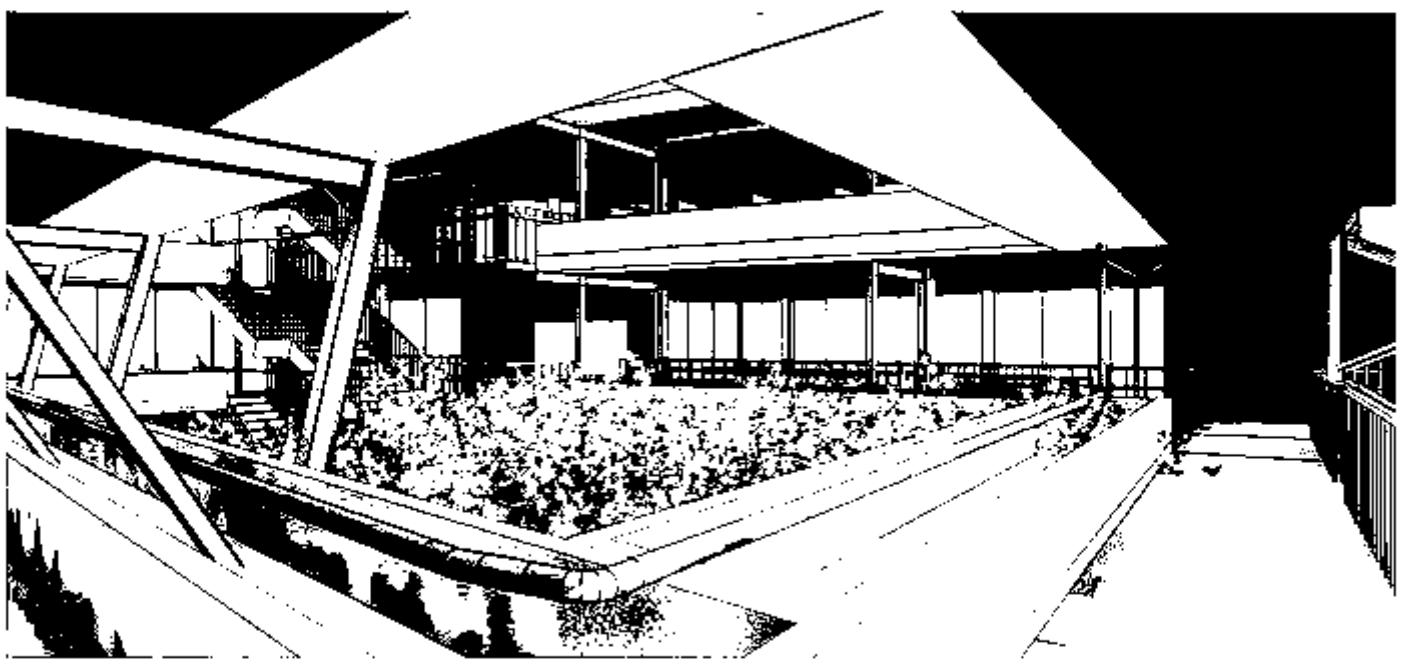


Image 109: Interior view on the first floor looking over the atrium to the south

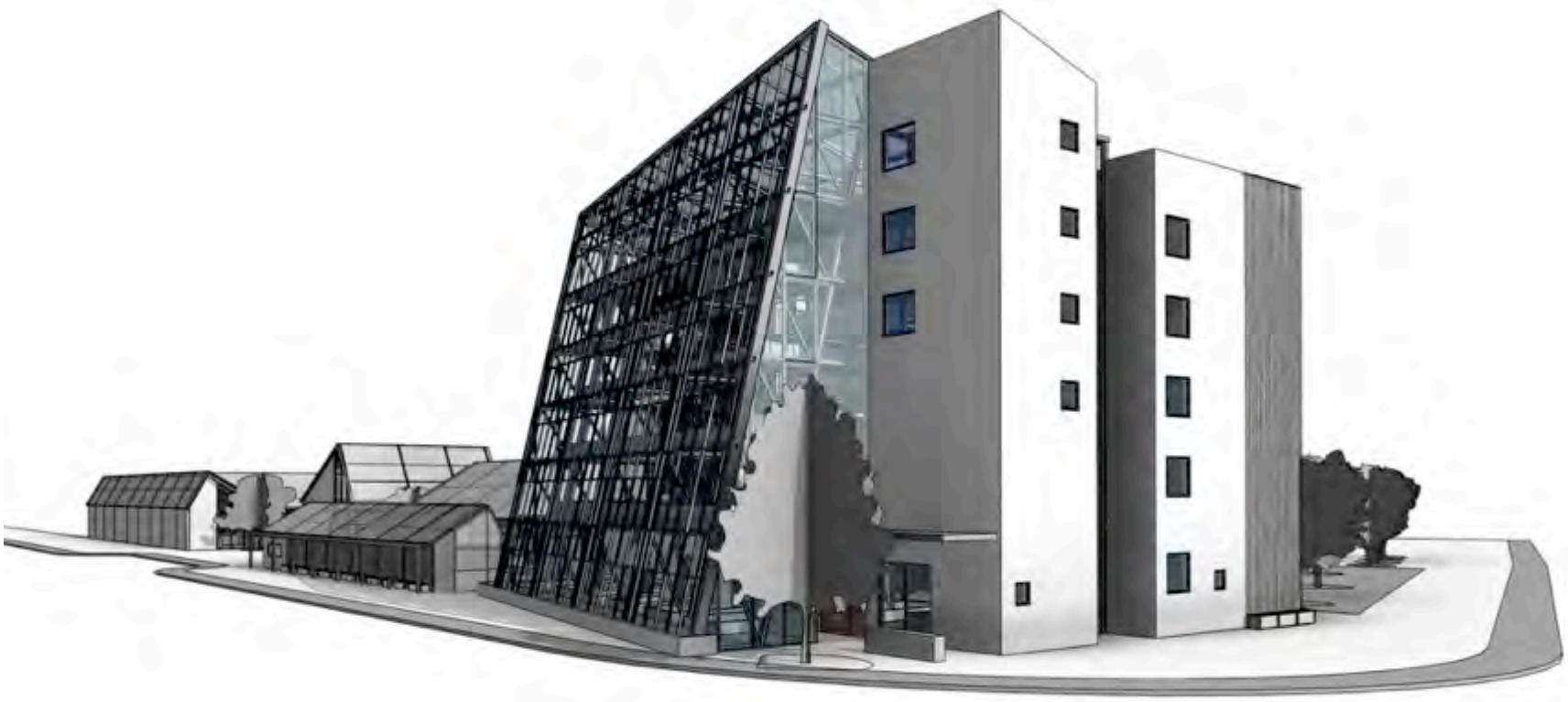


Image 110: 3D of the greenhouse

Image 111: 3D of the western façade of the greenhouse

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Image 41 & 42: Images courtesy of SOGH studio 2016, adapted by Author, 2016

Image 43 – 46: Author, 2016

Image 47 & 48: Images courtesy of SOGH studio 2016, adapted by Author, 2016

Image 49 – 111: Author, 2016

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